# THE ART OF INVENTING


EGGS CAN BE FRIED ON A CAKE OF ICE

Through an electrical property known as hysteresis This is a principle which may some day be responsible for frictionless railway trains and new forms of heating

# THE ART OF INVENTING AND WHAT TO INVENT

RAYMOND F. YATES

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*"Edison's Secrets of Invention,"*
*"Exploring with the Microscope," etc.*

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TO

M. L. Y.

WHOSE FRIENDLY LAMP SHONE
THROUGH THE LONESOME NIGHT

# PREFACE

THIS book deals only with the practical and teachable elements of a subject that has long been placed in the unteachable category of the attributes of genius. A man may be taught to paint pictures, build bridges, design ocean liners and skyscrapers, perform appendectomies, design radio or television sets, and yet the very ordinary use of the human faculties in the solution of the thousands of obvious problems that surround us each day is assumed to lie in the realm of genius.

The present treatment does not appeal to genius. It is not by any means intended as a guide-book or a source of inspiration for the wild-eyed inventor working in his attic to bring free power to the world. It is intended only as a guide for practical, hard-headed men who are able to see some of the thousands of improvements that can and will be made in the many articles that are in use today.

The author wishes to acknowledge the courtesy of Prentice-Hall, Incorporated, for their permission to use the license contract form, which was taken from their excellent book entitled *Patent Royalty Contracts* by Max W. Zabel.

R. F. Y.

# CONTENTS

## ILLUSTRATIONS

## DIAGRAMS

# THE ART OF INVENTING

# THE ART OF INVENTING

## CHAPTER I

### GENIUS VERSUS COMMON SENSE

IF the material progress of the world were left to genius, or at least to what is ordinarily looked upon as genius, we should still be living with the inadequate comforts and the doubtful luxuries of medieval times. In the early history of the race, man discovered. Today he invents, and inventing is a deliberate and planned process of thought and action wherein some predetermined result is sought. Inventors, on the whole, are practical men, capable first of recognizing a real human need and then applying well-recognized methods of solving the problems incident to the fulfilment of that need. This lofty and indeterminate thing called genius is not nearly so important a factor as one might imagine, if it exists at all.

Edison was one of our truly great inventors who did not believe in the theory of genius. It was strange, too, that the very man who was to many people genius personified should reject the postulate that genius mattered, or that it was a quality peculiar to inventors. Edison called invention 2 percent inspiration and 98 percent perspiration, which is probably as neat and as descriptive a definition as could be imagined. The

fanciful imagination and the dreams of the attic genius who would upset the world with his new source of power or his 1,000-mile-an-hour airplane were not even considered by the man who had over 1,200 patents to his credit and whose inventions had founded several billion-dollar industries. To him invention was just like any other field of human endeavor. It required a certain amount of common sense, a certain degree of concentration and patience, some technical know' of the problems to be solved, and enough business judg to guarantee for the inventor at least one half of the debt society would owe to him as a result of his labors.

There was a time, perhaps, when invention by inspiratic was responsible for more improvements than was invention by deliberation, but that was many years back before the advent of modern technology. Even today men have sudden inspirations when some happy solution will suggest itself, but the number of these cases that develop successfully forms a distinctly insignificant minority. Invention has at last reached the position of a profession and it has been reduced to a more or less definite formula. The professional inventor today takes his place with the professional engineer and the doctor, and he either works for himself or he is employed in the research laboratory of some large corporation. Nor is his a hit-or-miss profession. Doctors bury their mistakes, engineers are responsible for great financial losses, and architects design buildings that become landmarks dedicated to their stupidity and lack of sense of beauty. So it is with the professional inventor. His patents do not always cover machines or devices that are worthy of his calling. Yet on the whole, and even though 60 percent of the patents issued in this country are more or less worthless, the professional inventor is a most important member of society, and his contributions to its well-being and com-

fort are perhaps greater than that of any other single class of men.

This book, however, has not been prepared to help men who have succeeded in invention. It has been written with the aim of helping and encouraging the man who would invent but who, either because of his pathetic respect for men who have succeeded, or because of his firm belief in the need for that mysterious quality of genius, has made no effort to tap the well-spring of his own creative faculty. Men of this stamp are legion in the industrial world today and many ideas of tremendous worth to the world have died with the timid but clever minds that gave them birth. These potential inventors lose sight of the fact that invention has a heritage that demands too much esteem, and that a history of the art would reveal the names of thousands of ordinary men who have made themselves wealthy and the world a better place to live in because they had a tiny spark of faith in themselves. Samuel Morse, the inventor of the telegraph, was a portrait painter; Edison was a telegraph operator; Robert Fulton was an artist; and Eli Whitney was a school teacher, to mention but a few of the big names associated with invention in this country. To think that an artist, rather than a mechanical engineer, should perfect a steamboat at least leaves one secure in the thought that invention offers an open door to any mind that can see beyond its own and immediate environment.

Those who have had the good fortune to see successful inventors at work and who know something about the methods used by these men cannot agree with the chap who would enter the field but who feels deficient in training—especially technical training. While it is true that some inventors with good technical backgrounds have done many great things, it is also true that such formal training is not absolutely necessary. The

successful achievements of men without formal technical training stands as proof on this point. As a matter of fact, it often happens that the mind that is uninfluenced by precedent has a better chance of succeeding than the mind that is filled with theory. When Edison was at work on the electric light, a few men in high scientific places held that his attempts would prove futile for the reason that light without combustion was impossible.

Although many psychologists will not subscribe to his theory, it has long been the opinion of the writer that men with vast accumulations of knowledge are very apt to show no talent in the perfection of inventions. Their imagination is very apt to be crippled and ineffective. The reason is not difficult to understand. When the mind burdened with a wealth of information attempts to analyze a problem, so many associated thoughts and facts will rush to the focal point of attention that confusion results, and clear, straight thinking will be more or less impossible. It is generally acknowledged, for instance, that Edison at seventy years of age was not the same Edison who startled the world with his rapid succession of ideas at thirty-five years of age. The years of work and experience had filled his mind with many things, and his imaginative process became labored and rather ineffective; it had to jump too many hurdles, it had too much to deal with. Complication and complexity had set in and precedent had worn mental grooves where once sheer doubt had thrown down the gauntlet.

It is the unburdened mind, fresh and clean and armed with the bare fundamentals of physics, that is most apt to find the path of least resistance between an idea and the reductions of that idea to practical form. The pedagog has preconceived notions; he is dogmatic and is very apt to cry, "It can't be done," long before the necessity for such an admission arrives.

Men of this type never take a chance; they never gamble on the possible outcome of a new and apparently questionable experiment. Hence they experiment in their minds more than they experiment on their laboratory tables. In short, they know too much.

On the other hand, the inventive type unhampered with vast funds of knowledge is silly enough to conduct experiments and to try schemes that offer little or no promise. At the moment they may think that they are on the trail of possible solutions, but they are guilty of performing many useless tests. Therein, however, lies part of the essence of true invention. Inventors are pioneers. They are looking for ideas, for slants, for new methods of attack, and for suggestions. Therefore the smallest experiment is justifiable. It may bring forth a new lead; some scarcely observed little effect may bring forth either a totally new idea or the reconstruction of an old idea. Inventors are never too proud, too bull-headed, to try anything once. Acheson was clumsily searching for a method of impregnating clay when he accidentally discovered Carborundum; and a small piece of sulphur dropped from a shelf into Goodyear's pot of rubber brought an answer to the problem of vulcanizing. Edison unwittingly discovered radio waves as a sort of by-product to one of his many experiments, and many other major discoveries have resulted from experiments that had other objects. Necessity is far from always being the mother, or even the stepmother, of invention. The whole imperfect world lies spread out before every individual, and the men or women who will stop and measure the inefficiency of things about them, and apply common sense in overcoming the problems involved, will have excellent opportunities to enrich themselves and the world.

## CHAPTER II

### THE DISCOVERY OF HUMAN NEED

PERHAPS "What Not to Invent" would have been a more apt title for this chapter. Tragedy though it is, eight inventors out of every ten labor over devices that either are economically unsound or fill only a highly imaginary human need. In thumbing through the weekly issues of the *Official Gazette of the United States Patent Office,* one is appalled at the large number of fanciful contraptions which, if they did not represent the sweat and labor of poor and disillusioned souls, would be truly humorous. Such things as rocking chairs driven by electric motors, and counters attached to hens to count the number of eggs laid, have been provided with the dignity of patent protection by men who, though they might be ingenious enough, have entirely missed the elementary principles of their art.

The uneducated inventor is easily misled, not only by his own reasoning, but by the flattery and encouragement of his relatives and associates who, perhaps, know less about the problems in hand than he does. His enthusiasm engulfs him, smothers out his reasoning, and lays him open to all sorts of wild and possibly fraudulent schemes. Here is the new quick way to wealth, happiness, and recognition! Quick wealth has often been won by inventors, even poor inventors, to be true; but the chances, it must be confessed, are distinctly against the man who has not armed himself with sound judgment and a keen sense of commercial values. We live and move in an intensely

practical, hard, and materialistic world, and woe be to the man who does not gear his imagination to actual human need.

When an inventor becomes inspired with a new idea, his first and only thought should be that of subjecting the idea to unmerciful criticism. In short, he should attempt to bring forth every possible reason as to why the idea should *not* be patented. If he does not trust his own sense of proportion and his own judgment, he should consult people who are in a position to know. To believe in the practical nature of the idea is not enough. That it should function perfectly and meet all of the needs of the particular application for which it was intended does not, unfortunately, guarantee its success. It may still bring nothing but heartaches and ultimate disillusionment.

Untrained inventors rush to conclusions too quickly. They are fathers of faultless brain-children for no other reason, perhaps, than that they are *their* children. The pride of human possession, whether that possession is in the mind or in the hand, is a pride that conquers all of the dictates of logic and reason. Fundamentally it is, perhaps, an extremely valuable human trait, in that it makes a man fight and sacrifice for that which he calls his own; but if it is left unguided, especially in the field of invention, it will more often lead to ruin than to fortune.

Perhaps one of the first facts that must be faced by every inventor is that of human resistance to change. It is a dogged, bull-headed, and fundamental resistance, walled in by habit and sanctified by tradition. Solemn prayers were said in the churches of this country by people who begged God to protect them from the iniquity of the first railroads; and Bell was laughed at during the Philadelphia Exposition when he attempted to demonstrate his first workable telephone. Of course, in the face of it all, the world has changed and will change. Fortunately it ac-

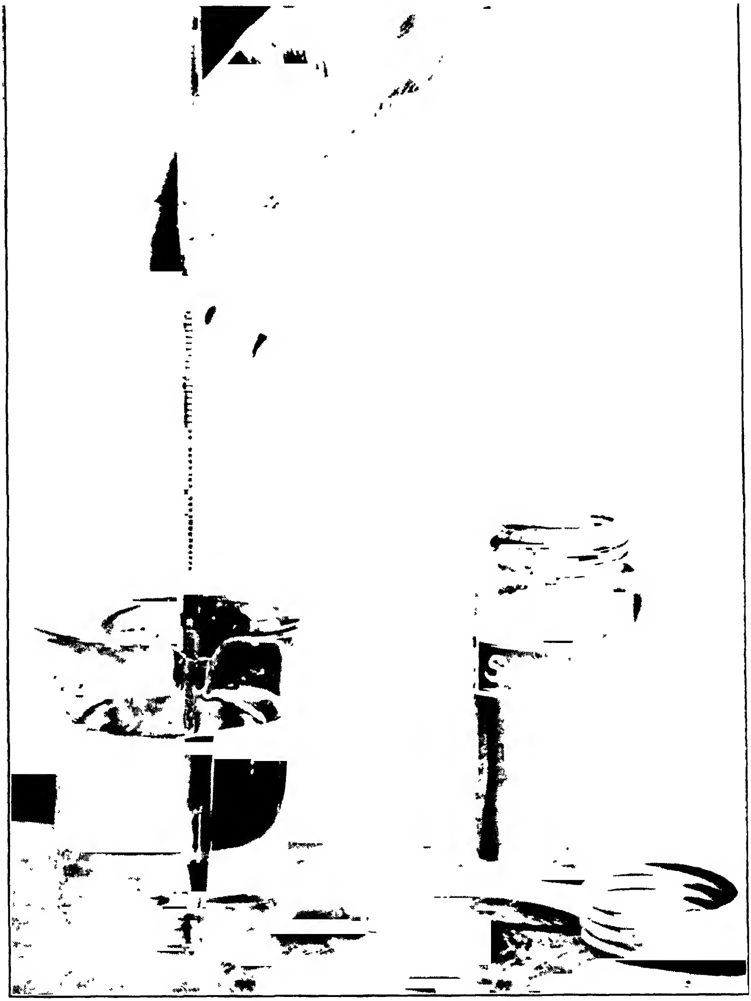
cepts new ideas a little more easily than it used to; but som of the old objections are still present, and the "newfangled" ide always has to fight its own way into the lives of those whom i would help most.

Many of our changes have been made with disarming smooth ness and subtlety. Precious few of them have been abrup enough to build up a barrier that could not be worn away. Peo ple still fight sudden changes with the age-old spirit of rebel lion, and every successful inventor must keep this fundamenta fact in mind. Otherwise he will some day come face to fac with it, and it is perhaps one of the most discouraging forces a work in the world.

But just what do we mean by abrupt changes? Reference is made to changes that offer too large a breach between the way things *have* been and *are* being done and the way that they *can* be done. The way that they can be done might be better, faster, less costly, and less laborious; but if it jars habits that have been long set, the ultimate victory will be gained by habit. A case in point happens to be that in connection with a large New York advertising agency whose client manufactured household ammonia. This agency sought some method of making this particular brand of ammonia distinctive, although it was, sure enough, just like all other kinds of ammonia. Finally the manufacturer was prevailed upon to add a coloring matter to the ammonia. Retail sales immediately dropped almost to zero.

The world is constantly changing, to be sure, but it is a gradual, painless change. The inventor or the manufacturer who attempts to accelerate this change beyond a certain definite point is bound to meet the most shocking and ruinous resistance.

There is another and less obvious angle to this matter that must also be considered by the inventor. The manufacturer oftentimes resists change for more substantial reasons than



A SIMPLE PRINCIPLE OF REFRIGERATION

The temperature of a glass of water is lowered when table salt is dissolved in it While this principle has been applied to refrigeration, home refrigerators still use gases, and the opportunity to apply this and several other scientific principles to the problem still exists

mere habit. If an inventor, for instance, came out with a razor blade that would never wear out, he would have a very difficult time interesting any of the well-known manufacturers of such articles for the simple reason that they would undermine their businesses by offering such a thing to consumers. If the blade were not radical in its shape or use, the public would buy it; but the inventor would have a most difficult time trying to find an independent manufacturer large enough to merchandize it in a country the size of the United States. Replacement is the life-blood of a number of our industries, and the man who invented an automobile tire that would wear forever, or for at least 100,-000 miles, would have far more trouble introducing his article than he would on first thought believe.

Unhappily this is not the only reason that manufacturers have for refusing to take on new products. Some years ago a gentleman from the West invented a radical new lawn mower that operated on an altogether new principle and looked like anything but a lawn mower. It was a fairly efficient device, it had a reasonable life, and it did its work well, to say nothing of the fact that it could be sold at a price much lower than that asked for articles of standard design. With all of these advantages, the article was a commercial failure. First and most important, no established manufacturer of lawn mowers could be interested in the article. One manufacturer put it very plainly when he said that he had $1,700,000 invested in machinery, much of it of special design, for the manufacture of his standard article, and that he would have to junk 70 percent of this valuable equipment and invest nearly $1,000,000 in new machinery if he were to manufacture the new device on a mass-production basis. Then he was confronted with that old and well-known bogie, sales resistance. Would the public buy the thing after it was produced? This and other important con-

siderations militated against the idea, and it eventually died that sad and inevitable death that comes to every idea that violates the solid principles of change. Every manufacturer has profits and investments that must be protected, and it is no light matter to jeopardize these profits and investments with uncertain ventures.

We have inventors who appear to think that manufacture is brought about by some magical process and that there is no such thing as preparation. This preparation is ordinarily called "tooling up," and the automobile industry alone spends many, many millions of dollars annually preparing its equipment for new models. A single die may cost as much as $50,000. If any article intended for wide distribution is manufactured, it must be done on a mass-production basis to cut costs, and this sort of preparation is extremely costly. It is facing these costs that makes any producer think twice before he decides to take on a new item. It must possess commercial possibilities beyond all question of doubt before the terrific risks involved can be justified.

Another question that every inventor must ask himself is "How much money will my idea save?" Will it do the old job as well as the old equipment and at less cost? Can it be manufactured at a cost commensurate with the advantages that it possesses over the conventional equipment? If the new design can be manufactured more economically and will do its work better and more cheaply, the ideal situation is arrived at and the invention will easily find a buyer. Such, however, is rarely the case, and the inventor is often called upon to make extremely important decisions to determine whether or not he shall abandon an idea before he has squandered much of his time and labor in its perfection.

The question of human need still looms up as the most im-

portant one that every inventor must *always* face. Can the invention justify its existence? In almost the same category there lies the question of the width and breadth of the need. Comparatively few inventions, such as hairpins, pencils, corsets, watches, and other widely used little items, have purely personal applications. Most inventions appeal to a special class of people or to special conditions. As a whole, the more widespread the need, the greater the prospects for large financial reward; but most inventions are highly specialized and, if too highly specialized, they defeat themselves.

Cases are on record where only a few machines of a certain type have been sold, but sold under conditions that forced a handsome profit for their inventors. At the time of writing this book, this country has in use three machines for the manufacture of linoleum that have been invaluable to the people who own them because they have sliced such enormous amounts off the cost of manufacturing this material. These, however, are special cases that are, on the whole, of little interest to the average inventor pondering over smaller gadgets.

In general, it can be said that the inventor should confine his attention to problems that have the largest possible appeal and application. This is not an iron-bound rule, but it fits the case of the man who is not in a position to specialize. Specialization should be attempted only after mature study. Each industry has its own set of economics and its own problems that are best solved by men who understand them. A man who has been in the habit of perfecting gadgets for the chain store trade cannot hope to step into the shoe industry and produce new shoemaking machinery that will revolutionize that industry overnight.

The competition existing in the field to which his invention applies is another factor that must be permitted to figure in any

inventor's calculations. There is not only the question as to whether or not the article can compete with articles already on the market, but there is also the question of the basic competition in the field. If the field represents a monopoly held by one manufacturer, that is one thing; and if the market is fought for by a dozen manufacturers, that is quite another thing. If an inventor's idea is fundamentally sound, a competitive market between warring manufacturers is to be desired because it will stimulate competitive bidding for the new idea. On the other hand, if the market is controlled by a monopoly, the inventor is placed at a distinct disadvantage, and situations of this nature are, on the whole, to be avoided. Monopolies usually enjoy good business, they do not *have* to change, and changes cost them large sums of money.

It is hoped that the student inventor will have learned from this chapter that economic consequences are often at variance with enthusiastic first thoughts and rosy predictions. It is the part of the hard reality to be faced by every man who decides to cast his lot with those who attempt to improve the world. The student is also warned that this chapter has but hinted at situations and suggested matters that must be thoroughly investigated in case the reader actually launches himself in some new enterprise. Each situation presents its own special problems and has its own set of answers. What the inventor needs is an economic sense.

Very few inventions are inspired or come to the inventor's mind in sudden flashes. If a man depends upon inspiration or chance discovery of need, he will rarely make money with his ideas. Worthwhile inventions are more often the result of deliberate thought and careful analysis of the shortcomings of the many articles by which we are surrounded. Nothing is perfect, and this fact should ever be in the mind of the man who

would improve the world and the luxuries of life. Everything that we use is in a measure crude and imperfect. Only cautious study and contemplation will reveal this imperfection and suggest possible remedies for it. Sometimes these remedies are more or less obvious, but more often they suggest themselves only by painstaking thought extending over a period of weeks or perhaps months.

Thus it is that many men who have capitalized on their ideas spend much of their time examining and criticizing the commonplace articles with which they come in contact. The fact that a certain design for an article has not been changed in years does not mean that it will never be changed or that the present design even meets with the most rudimentary concepts of perfection. To the man with an eye for improvement, nothing is sacred, nothing has reached its final state of maximum human usefulness. For over a century, clever men have occupied themselves with the improvement of locomotives, and the files of the Patent Office hold thousands of patents devoted to this machine; yet locomotives are among our most inefficient and wasteful consumers of power, possessing an efficiency rated at a bare 8 percent. Nor does one have to go to locomotives to discover such mechanical misfits. It so happens that the degree of perfection in such cases can in a way be actually measured; but this is not so with thousands of other articles that find wide daily use. This sort of inefficiency must be discovered by our inventors.

The purely habitual use of many articles has a tendency to throw us off our guard. We perform many operations more or less automatically. We probably unconsciously shift the gears on our automobiles many times daily while we are thinking of other things. So it is with half of those mechanical devices that form such an important part of our daily environment. Clever

is the inventor who stops to think, to ponder, and to turn things over in his mind, asking questions and seeking answers that will square with good practice and good economics. His quest in the discovery of need never ends. Never does he have to ask himself the question, "What shall I invent?" He is surrounded with thousands of half-baked ideas. If he is at all keen and analytical, the opportunities for improvement will appal him, and he will not know where to begin. In the kitchen we have egg beaters that are slow and hard to wash, knives that are easily separated from their handles, gas stoves that dissipate most of their heat uselessly, electric percolators that cannot be washed in the dish pan, food choppers with crude adjustments, traps in sinks that are bound to plug, faucets that *must* eventually leak, tea-kettles with handles that burn or become too hot, salt shakers that do not protect their contents from moisture, and dish-washing machines that are a disgrace to the mechanical age in which we live. And still inventors who have not cultivated the critical frame of mind search for things to improve!

It quite often happens that the mere discovery of a need will supply the answer. The man who kinked a hair pin to make it hold its position could not have spent very many sleepless nights in offering a solution to this problem. His was an obvious answer that could have been supplied by thousands of men and women had they been smart enough to stop and think about the matter. The genius back of many inventions has involved the recognition of a problem rather than its fulfilment. True invention is as often as not the mere discovery of a problem rather than the solution of that problem.

The inventor with a mind constantly alert to improvement is always asking himself questions. When he handles a camera, a pocket knife, a wrench, or any of the thousands of mechanical

items that we humans use daily, he asks himself, "Is this thing really efficient?" Where can it be improved? Can its usefulness be increased by finding new applications? Can its manufacture be cheapened to any considerable extent? Can any of the present parts be eliminated without impairing the efficiency of the article? Can a radical new principle be used to replace this old method? Can the operation performed by the old device be speeded up by a simple addition? Can the life of the article be increased? Can pressed metal be used in place of drop forgings or castings? Can the article be made smaller or lighter?

Thus do thoughts filter through the inquiring, inventive mind. The first postulate is that nothing in the world today even remotely approaches perfection. Then, there is not only the possibility of improving things that have been invented, but also the invention of things that are totally new. When the first typewriter made its appearance, it was a new idea. Nothing like it had ever been suggested; and there is still just as much opportunity for really new things as there was in the days of the early writing machines. The application of the photo-electric cell has been responsible for the introduction of several new machines during the past few years, the most revolutionary one taking the form of an automatic cigar sorting machine which brings about color and shade classification far beyond human attainment.

It is one thing to invent and another thing to effect public acceptance of the thing invented. The public is always ready to buy something new and clever that it can use, but more often the inventor misses his mark because of his own enthusiasm rather than through public apathy or reluctance to make a change. It must also be confessed that the public has been known to reject a number of very ingenious and useful articles, although this is the exception rather than the rule.

None the less, the inventor will do well to reduce all chances to a minimum, and it is therefore often advisable to consult friends and relatives regarding household and kindred objects before money is spent either in perfecting or exploiting them. Many valuable opinions are brought to light in this manner, especially if the inventor will impress the persons asked with the fact that their opinions will be without value if they are not given frankly and with no attempt to flatter.

An inventor should certainly never trust himself with an opinion. No one has ever heard of a mother uttering anything but sweet and lovely things about her new-born. She has a justifiable pride. The inventor has the same pride, and it is neither justified nor reasonable. He is the last person in the world who should be trusted to form an ultimate opinion. This is not 100 percent true, but it is sufficiently close to it to apply generally. This is all very human and very much to be expected.

The man with an idea for a new kitchen gadget, for instance, is in a very poor position to measure the merits of that article with any degree of accuracy. The best thing that he can do is to build one and pass it among his friends for actual use. If it saves precious time for bridge or golf, and if it can be manufactured cheaply, it will probably "take." If it is an obvious idea and its application can be instantly understood without detailed directions and diagrams, that is another thing in its favor.

The writer has known inventors, clever enough to be fearful of their own ideas, who have always sought out the opinion of experts in the line to which their inventions have applied. Often enough they seek out manufacturers engaged in the fabrication of similar articles. While such opinions are undoubtedly of value at times, they should not be taken as the last word. It is difficult to obtain unbiased opinions from thes

sources for the reason that the manufacturer is a bit prejudiced in favor of his own product. That, after all, is his child. Furthermore, he is not looking forward with any degree of pleasure to competition that such an article might establish. The fact that he might be given first chance to sign a contract with the inventor is not always as alluring a possibility as might be thought. This particular company might have $30,000 invested in tools and dies, and it might not feel that the new invention represented enough vital improvement to warrant junking this valuable equipment. Hence the dubious opinion. It would not necessarily follow, however, that competitors of this producer would feel the same way about the matter, especially competitors who were weaker and who were looking for some sort of an advantage. Here the inventor is called upon to form his own opinion, and the facts of each case must determine the course of future action.

The writer has known several inventors who sought their inspiration in a book devoted to the various mechanical movements, feeling that if they studied this book long enough, and juggled the mechanical elements around in their minds, they would eventually stumble upon a new and valuable application of an old principle. While certain types of minds might be stimulated on such mental diet, it is at best a haphazard and precarious method. Everyday environment is the inventor's best research laboratory, for it is in this laboratory that he finds things working and is exposed to their shortcomings and their failures.

Some men prefer to confine their efforts to fields in which they have had some experience, feeling more at home and better able to determine the worth of their ideas. This may be true enough, but why limit one's efforts to a single field when the whole imperfect world lies spread out before one? The opportu-

nity is limitless, and there is little excuse to overlook all but a tiny portion of it. Furthermore, some of our largest fortunes have been built up by versatile inventors who put no bit in their mouths and hesitated at nothing so long as they sensed improvement. Edison was such a man. His twelve hundred odd patents covered a truly staggering diversity of things. Popular fancy had put him down as an "Electrical Wizard," but that was like pushing him off into a corner where he did not belong. What about his phonograph inventions, his concrete formulae, and his moving-picture machines? Specialization may fit the temperament and mental equipment of some inventors, but it is not a thing to be aimed at, even though it might make one feel more at home and less apt to make mistakes.

What might be called "inventive alertness" is the thing to be cultivated in this constant search for human need. That nothing is perfect should be reduced to dogma. The widely heralded age of invention in which we live would lead to nothing but the dreary trump of doom if it were left to seek its own level without the aid of the millions of thinking minds born and yet to be born. Everywhere the inventor is surrounded with crass stupidity and pitiful efforts to solve major and minor problems. Pathetic indeed is the question, "What shall I invent?"

## CHAPTER III

### THE MEANING OF A PATENT

THE average would-be inventor is pathetically ignorant of the real meaning of a patent. To him a patent means that his troubles are over and that the vast forces of the United States Army and Navy stand back of him and his rights. And who, pray tell, would dare to infringe or to steal a patent with such a terrifying array of force ready to defend it? Put into so many words, this is a ridiculous conception of patent rights, but it is, nevertheless, one held by too large a number of people.

To fully understand the meaning back of the United States patent law, it is well to attempt an analysis of what would happen if we had no patent law. It is quite obvious that men would not divulge their new ideas; they would keep them secret. Nor would manufacturers come forth with new inventions and appliances, for as soon as they did so, other manufacturers, without the necessity of spending money over long periods of research and perfection, would appropriate the ideas and produce them themselves at less cost; cost that would not need to take into account the money spent in development. Industrial stagnation would result and, in the case of our own country at least, we should still be living in the dark ages of an unmechanized civilization.

The reasoning back of the various patent laws of the world is not difficult to understand. New ideas must be brought out into the open if they are to add to progress and the well-being

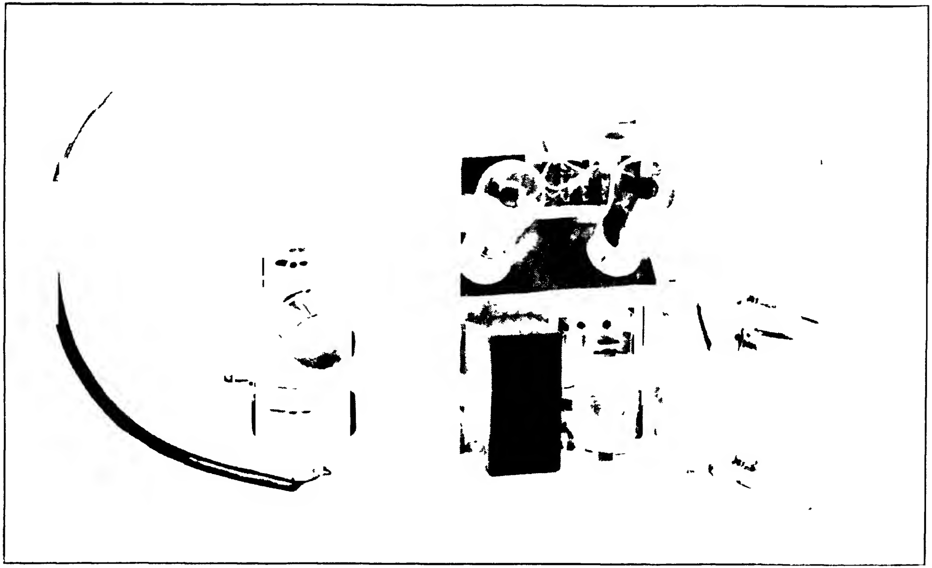
of mankind. Consequently when the real industrial age began to develop, the various governments proposed in the form of patent law certain guarantees and stipulations that gave the man with a new idea some prospect of realizing a financial return for that idea. The reward is given in the form of a monopoly which, in this country, is granted for a period of seventeen years. Once this period has expired, it is practically impossible to obtain an extension of the time. Such extensions can be granted by Congress alone.

During this period of seventeen years the Government of the United States gives the inventor the exclusive right to "vend, use, or sell" his idea, and the monopoly extended is conceded to be a very tight one once the inventor establishes his right to it—and that is where the boot sometimes pinches.

The Government gives the right, but it is left to the poor inventor to protect the right; and here it would appear that our patent system, which is acceptable to the strong, leaves much to be desired in the case of the weak. Thomas A. Edison once said that a patent was merely an excuse for a lawsuit, but this was perhaps putting the matter a little strongly.

To make this point more clear, it will be assumed that a patent is granted to an inventor and that within a short time after the public disclosure of the idea, the inventor finds that a manufacturer has directly infringed his invention. It may be a case of wilful infringement—though such cases are difficult to establish, for every infringer usually has some sort of a neat little excuse up his sleeve. If driven to it, he may make a weak attempt to prove that he had the idea first, or that his device was sufficiently different than that of the inventor to give him a degree of protection.

Of course, the poor inventor may think that all he has to do is to complain to Uncle Sam and the benevolent Uncle will at



THE PHOTO-ELECTRIC RELAY

Here is a case of old elements in new combinations The device is known as a photo-electric relay, by means of which machinery and operations may be controlled by a beam of light The inventors of labor-saving machinery will do well to investigate the possibilities of this remarkable new device, which is finding many industrial applications

once chastise the unruly member of his large family—or even force him to pay damages to the inventor, as a matter of fact. Frantically the inventor appeals to the Patent Office, where he is politely informed that nothing can be done. The Patent Office has washed its hands of the case once the patent has been issued. Slowly it dawns on the inventor that he must defend his own right by due legal action, which may and has carried inventors to the Supreme Court. Thus does our Government say, "Here are your patent rights, now go and fight for them." The matter appears somewhat paradoxical when viewed in this way.

Some inventors who have a little more knowledge of the law immediately rush to their lawyers when their ideas are infringed and attempt to have an injunction filed against the infringer. The trouble with this procedure is that it usually amounts to a waste of money and time, for the simple reason that no judge, or very few of them at least, will issue an injunction. The average judge is a little bit weak in technical knowledge and, judge-like, he prefers to be cautious with his pronouncement of law as it affects such cases. As a result there is nothing left for the inventor to do but to appeal to one of the lower courts and to have the case tried by "due process." If he obtains a favorable decision in this court, his opponent may carry the case to the next court in line.

This perhaps sounds very pessimistic and discouraging to a man with an idea or to a man who proposes to enter the field of professional inventing. It should not be so. While it is true that we have too many cases of expensive patent litigation, these cases are usually being fought out between large corporations contending for supremacy in certain fields. The history of invention in this country is, after all, a more or less glorious one for the poor inventor, and countless millions have been paid

in royalties to such men. Some of them have had to fight for their rights and some of them have not. The legal departments of corporations do not always court lawsuits; indeed they try to avoid them, and if they find that they will be beaten or are beaten cleanly and fairly, they are perfectly willing to pay the bill, no matter how large it may be. Another fact in favor of the inventor is that in the case of trials by jury, the jury is very apt to lend a patient and even kindly ear to the case of the poor man as against that of the huge corporation.

It has been said previously that our patent law gives the monopoly to the man who has the idea *first*. In some countries it is the man who first applies for a patent that receives the reward. Our own law states that the man who first reduces his idea to practice and shows the proper diligence in so doing will be granted the patent. This "reduction to practice" is a clause that confuses many beginners. By "reduction to practice" the law does not mean that the inventor is required to build a model of his idea to make sure that it works before he applies for his patent. It simply means that he must put his idea down on paper in a form that can be understood. In short, he must make a disclosure of his idea; he must bring it out of his mind and set it down in black and white. After all, the Government in its patent law bribes him to do this because it is the first step in bringing to light a new idea that may some day add to our national wealth and public good.

There are certain prescribed ways in which this reduction to practice is brought about. The careful inventor is always sure to adopt tried and tested legal methods in making his disclosures, and such disclosures are called "dates of conception." In the chapter on "Keeping Legal Records of Invention" the reader will find other references to this important matter, but for the moment the date of conception and its proper execution

should occupy his attention. As soon as a new and inspired idea takes on a more or less definite form (final perfection does not need to be arrived at), the inventor proceeds to sketch the idea out on paper in the best manner at his command. He should make every effort to put the thing down in such a way that a person knowing little or nothing about the art in question would be able to understand. The drawing does not have to be perfect. Clearness is the thing to be aimed at.

On this very same piece of paper the inventor writes his description in pen and ink. Pencil should not be used, and it is better to make the drawing in ink as well. After all, a document is being prepared that may some day have to be offered to the scrutiny of a court and jury, and there can be no question as to its authenticity and the fact that it has never been subjected to change. It is also important that the drawing and the description be made on the same piece of paper.

When this has been done, the inventor takes his paper to a notary public and has him place his stamp and date upon it. These things are done at the earliest possible moment. Tomorrow may be too late. It should be recalled that Alexander Graham Bell, the inventor of the telephone, beat his competitor to the Patent Office by a single hour, and millions were at stake. Furthermore, once the inventor has properly recorded his date of conception in the manner outlined, he can sit back and breathe freely, for the race is over, as far as he is concerned. Our patent laws give him two years after this disclosure to file his idea and apply for a patent. If he does not act within this time, his idea becomes public property.

No inventor, however, can ever make sure that his idea is new until he actually applies for a patent. To make this clear, an actual case will be outlined in which the writer once figured. He had applied for a patent dealing with a radio toy intended

for attachment to a radio receiver. He immediately executed a date of conception and proceeded to bring the article to a point of development where he was sure that it would function in a manner to warrant the expense of taking out a patent. This was done and the patent applied for within the year.

In due course, the writer was notified by the Patent Commissioner that an interference had been declared. By this was meant that somebody had filed application on a patent for precisely the same thing before the Office had completed its examination of the writer's case. In such cases the Patent Office asks for proof as to the real inventor, and there is a certain procedure that must be followed out. The Office must be provided with acceptable proof of the real date of conception in each case. If the proof of one inventor is not acceptable legally, the invention will be issued to the other inventor, even though he was not the first to have the idea and therefore not the true inventor. Of course, the defeated inventor can appeal this decision, but it will cost him money to do so and the chances are that he will lose his case. In the writer's case it was found that he had recorded an outline of his invention several months before the other inventor, and the patent was issued to him without further question. Not all disagreements of this kind have such simple endings.

Perhaps no case has justified the importance of the date of conception as did the long-drawn-out legal battle of Armstrong vs. de Forest in the effort to establish the rights of the all-important regenerative radio circuit. Armstrong was but a boy when he crudely drew up his specifications and circuits to have them witnessed before a notary public. Yet this insignificant little scrap of paper brought a court decision in his favor that later turned out to be worth over a million dollars.

Surely this case must emphasize in the mind of the reader the importance of the date of conception.

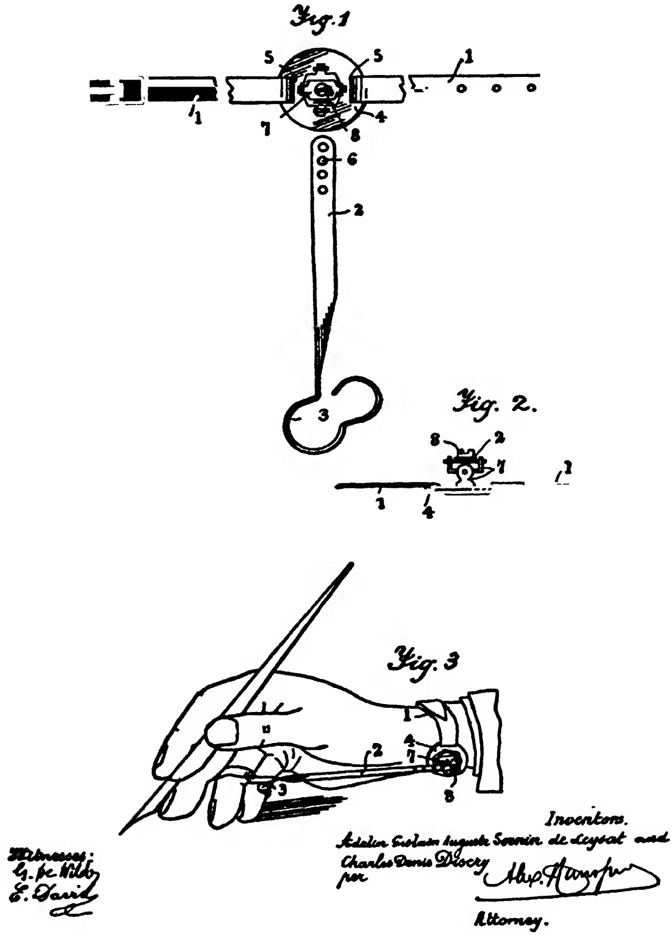
The patent that has been issued can be invalidated. Indeed, such things have happened and will happen again. Our Patent Office insists above all that the man who had the idea first and can prove it beyond question of doubt is entitled to the monopoly and the protection which monopoly provides. There is but one extenuating circumstance that will be considered in such matters, and that is diligence. In short, the inventor must demonstrate that he has made every effort to protect himself and to reduce his idea to practice within a reasonably short time.

In this connection, the citation of a well-known case will tend to bring out more clearly this idea of diligence, which is so keenly insisted upon by our courts. A large corporation had done some work upon a new idea, but it was felt that the time was not ripe for its introduction to the public. Hence the material and data that had been gathered on the subject were placed in the files and the idea abandoned for the time being.

One of the research workers in the company, who had been impressed with the future of this invention, left the employ of the company and gained a connection with another manufacturer. He introduced this new idea to the second manufacturer and research work on the idea was continued and eventually brought to a point of culmination. After the patent had been applied for and the idea introduced to the market, the first company sued for damages, claiming ownership of the idea and bringing its records to court to prove that ownership. Contrary to what might have been expected, this corporation did not win the case because it was guilty of action that defeats the whole spirit of the patent law: it had abandoned the

A. G. A. S. DE LEYSAT AND C. D. DISCRY.
APPARATUS FOR INSURING THE CORRECT POSITION OF THE FINGERS AND HAND IN WRITING.
APPLICATION FILED NOV. 29, 1920.

**1,379,804.** **Patented May 31, 1921.**




DRAWINGS TO ACCOMPANY A MECHANICAL PATENT

# UNITED STATES PATENT OFFICE.

ADELIN GISLAIN AUGUSTE SORNIN DE LEYSAT, OF ETTERBEEK-BRUSSELS, AND CHARLES DENIS DISCRY, OF IXELLES-BRUSSELS, BELGIUM.

APPARATUS FOR INSURING THE CORRECT POSITION OF THE FINGERS AND HAND IN WRITING.

1,379,804. Specification of Letters Patent. Patented May 31, 1921.

Application filed November 29, 1920. Serial No. 427,201.

*To all whom it may concern:*

Be it known that we, ADELIN GISLAIN AUGUSTE SORNIN DE LEYSAT and CHARLES DENIS DISCRY, subjects of the King of Belgium, and residents, respectively, of Etterbeek-Brussels, Belgium, and of Ixelles-Brussels, Belgium, have invented certain new and useful Improvements in Apparatus for Insuring the Correct Position of the Fingers and Hand in Writing, of which the following is a specification.

This invention relates to an improved apparatus for maintaining the fingers and hand in correct position when writing, and has for its object to promote an easy, rapid and regular script and to prevent writers' cramp.

In order to write well and rapidly it is necessary to observe the following principles:—

1. The pen must be held lightly between the thumb, the index finger and the middle finger in such a manner that the pen passes across the third joint of the index finger and points toward the right shoulder for sloping writing, while for upright writing the pen is raised a little.

2. The thumb, index finger and middle finger must be allowed the necessary freedom of action. These fingers, which form a mobile support for the pen, must be freed from the third and fourth fingers.

3. The third and fourth fingers must be united, depressed and maintained in a position approximately perpendicular to the forearm and must serve as a support for the hand.

4. The wrist must be maintained nearly one centimeter above the paper, more than half of the weight of the right forearm being supported upon the edge of the writing desk.

The present invention provides an improved apparatus for holding the third and fourth fingers separated from the remaining fingers in accordance with the principle set forth above and the invention consists, briefly stated, in an improved device for insuring the correct position of the fingers and hand when writing comprising a substantially rigid member pivotally secured at one end to a wristlet and adapted to engage and hold the third and fourth fingers at its free end.

In order that the invention may be more readily understood, the reference will now be made to the accompanying drawings in which:—

Figure 1 is a plan of the apparatus, showing the rigid member separated from the wristlet,

Fig 2 is an elevation and

Fig. 3 is a perspective view showing the apparatus applied to the hand.

The apparatus comprises essentially two parts: an adjustable wristlet 1 of leather, rubber, fabric, celluloid, metal or other suitable material and a removable strap 2 adjustable in length and formed from a thin steel strip, one end 3 of which is curved to form a clip adapted to hold the third and fourth fingers together in the position shown in Fig 3, that is to say in a position approximately perpendicular to the forearm The two members 1 and 2 are united by means of a circular plate 4 provided with slots 5 through which the wristlet 1 is threaded The strap 2 may be secured to the plate 4 by means of a screw which passes through one of a number of holes 6 formed in the strap 2 and engages in the plate 4 or in any other manner. As shown in the drawing, the circular plate 4 carries a universal joint 7 upon which the strap 2 is secured by means of a screw 8, this arrangement also allowing movement of the strap in any direction without altering the distance of the end 3 of the strap from the plate 4 when once this is fixed.

The operation of the device is as follows:—

The wristlet is lightly fastened upon the wrist above the joint with the clip turned opposite to the back of the hand and the clip formed upon the end 3 of the strap is then engaged over the third and fourth fingers of the hand slightly above the first joint of the third finger as shown in Fig 3.

The strap 2 must then be adjusted so that the two fingers are held in a position approximately perpendicular to the forearm by engaging the proper hole 6 upon the screw 8. This adjustment is permanent for as long as the apparatus is used by one person.

A MECHANICAL PATENT

Owing to its rigid nature, the steel strap 2 maintains the third and fourth fingers in the position already indicated and allows them readily to fulfil their function as a means of support for the hand and to glide easily over the paper. The thumb, index finger and middle finger are entirely detached from the third and fourth fingers and have perfect freedom to execute all strokes necessary in writing. In short the apparatus insures that the fingers are properly disciplined for writing while avoiding for the user, writers' cramp and other effects of fatigue which interfere with the regularity of the writing and the speed of the writer.

These important advantages render the invention suitable not only for infant schools where it is of great use for children learning to write, but also for more advanced scholars who are often under the obligation of making rapid notes, for professional writers, draftsmen and the like.

We claim:—

1. Apparatus for insuring the correct position of the fingers and hand in writing, comprising, a wristlet, a circular plate secured upon said wristlet, a thin steel strip having two ends, an adjustable pivotal connection between said plate and one end of said steel strip, and means for engaging and holding the third and fourth fingers of the hand in the other end of said steel strip.

2. Apparatus for insuring the correct position of the fingers and hand in writing comprising a wristlet, a circular plate secured upon said wristlet, a universal joint, mounted upon said plate, a thin steel strip having two ends, an adjustable connection between said universal joint and one end of said steel strip and a clip formed upon the other end of said steel strip.

3. Apparatus for insuring the correct position of the fingers and hand in writing comprising a wristlet, a circular plate secured upon said wristlet, a substantially rigid connecting member having two ends, a pivotal connection between said plate and one end of said connecting member, and means for engaging and holding the third and fourth fingers of the hand at the other end of said connecting member.

In testimony whereof we affix our signatures.

ADELIN GISLAIN AUGUSTE SORNIN de LEYSAT.
CHARLES DENIS DISCRY.

Witnesses:
J. J. ZALREES,
EMIL VAN WARZELLE.

CONTINUATION OF MECHANICAL PATENT

idea. The motives behind this abandonment, no matter how worthy, were not considered as being important enough to prevent the giving of the monopoly to the manufacturer who had rushed the idea to its logical conclusion. The patent law was framed to bring new ideas out into the open where they will be useful, and not to keep them buried in the files of corporations.

If our patent law is viewed broadly and interpreted correctly, it will be discovered that on the whole it cares little for the individual. It is the welfare of society as a whole that concerns the patent law most, and if there is a communistic document on our statute books it is this. The inventor will do well to keep these facts in mind at all times. The broad view is the best view and will do most to reveal the true purpose and spirit of this document. The individual is simply bribed and cajoled into disclosing any ideas that he may have for the betterment

# UNITED STATES PATENT OFFICE.

JOHN FEENEY, OF LODI, NEW JERSEY.

PROCESS FOR TREATING WICKS.

1,379,857. Specification of Letters Patent. Patented May 31,

No Drawing. Application filed December 18, 1920. Serial No. 431,799.

*To all whom it may concern:*

Be it known that I, JOHN FEENEY, a citizen of the United States, residing at Lodi, in the county of Bergen and State of New Jersey, have invented certain new and useful Improvements in Processes for Treating Wicks, of which the following is a specification.

This invention has relation to a process for treating lamp wicks or the like to render the same smokeless and more durable, as well as to impart other qualities which render the wick more desirable than untreated wicks as will readily appear as the invention is more clearly understood.

In addition to the foregoing the invention comprehends the exact steps of the process to be hereinafter set forth, the exact chemicals and their chemical equivalents as well as other alterations in the exposition to be set forth within the spirit of the invention and the scope of the appended claim

As a preliminary operation to the treatment of a lamp wick it is necessary to prepare a solution which consists essentially of lime and water. For this purpose I procure a good quality of unslaked lime or calcium-oxid which is immersed in water and permitted to slake. The proportion may vary, but I have found that three parts by weight of water to one part by weight of lime is a combination that is of the best results. As stated above the lime is permitted to slake with the accompaniment of heat. And the mass is thoroughly stirred and permitted to stand until it is found that a sample of the liquid when drawn off will have a specific gravity of one degree, or in other words until the strength of the liquid is such as to render the same 1.100 times the weight of water. It is absolutely necessary that the solution of lime attain this strength before proceeding with the further steps of the process. However, after the solution has attained this strength and permitted to settle the clear liquid is siphoned off from the sediment and it is this clear liquid which is used for the lamp wicks A desired quantity of the liquid is placed in any suitable container which may be heated and the wicks immersed in the liquid and boiled. The proportion may vary, but I have found in practice that two parts by weight of solution would be sufficient to treat five parts by weight of the wicks. In any event the immersed wicks are boiled for three hours or until a sample of the liquid drawn off will be found to have increased in strength to one and one-half degrees on the hydrometric scale or in other words 1.500 times the weight of water. It is necessary that the solution arrive at this strength before the boiling of the mixture is discontinued. However, as soon as this point has been attained the wicks are removed and then thoroughly dried. They will be found to have acquired a whitish appearance and to have altered somewhat in the internal structure of the fibers which could not be seen except upon microscopic examination. It is in the results that the difference between the treated and untreated wicks is noted. It has been found that such wicks result in the production of a clear smokeless flame when used in lamps or stoves of the inclosed type or with the production of a smokeless blue flame in stoves of the Argand burner type. Furthermore, the wicks are more durable than untreated wicks and will not accumulate a carbonized edge.

Other peculiar qualities are imparted thereto which will only render themselves apparent after one has an opportunity to use the wicks and to note the superior results obtained.

While I have described my invention with considerable particularity, the ingredients employed in my process as well as the various steps may be varied by others in an attempt to avoid the protection afforded by my patent. I therefore desire to reserve the privilege of modifying the exact order of the step as hereinbefore outlined, to alter the various quantities of materials used as well as to employ other chemicals which may be considered chemical equivalents of those stated, without departing from the spirit of the invention or the scope of the appended claim.

Having thus described my invention what I claim as new and desire to secure by United States Letters Patent is:—

The herein described method of treating

A PROCESS PATENT

2 1,379,857

lamp wicks which consists of first preparing a solution of lime water to a strength of one degree on a hydrometric scale, then immersing the wicks in the solution, then boiling the wicks and solution for three hours or until the solution has reached the strength of one and one-half degrees on the hydrometric scale, and finally drying the wicks.

In testimony whereof I affix my signature in presence of a witness.

JOHN FEENEY. [L. S.]

Witness:

Wm. Zeaman.

Continuation of process patent

of the race and the enrichment of the country in which he lives.

At times it would appear as though our patent law were all but contradictory. It can and does happen very often that an inventor has only very limited rights in the use of his invention. He finds himself quite in the power of another patentee. This happens only in the case of what has come to be known as "improvement patents," patents that provide further perfection for patents already in force. It must be obvious that such patents cannot be used except by the consent of the holder of the patent covering the original device. On the face of it, this might appear a bit unfair; but if the matter is maturely considered, it will be found that such limitation of monopoly is quite unavoidable and that it does not violate the spirit and purpose of the patent law in general. It certainly must be clear that the first and original inventor of the device must be the favored party. Indeed, the improvement patent would have been impossible had not this party supplied the inspiration of it.

It goes almost without saying that the second inventor of the improvement cannot manufacture the device covered by the original patent without the full consent of the first patentee. This does not imply, however, that the inventor of the improvement cannot find a market for his article provided that it offers technical advantages.

Hundreds, even thousands, of improvement patents have

been sold, and while it is true that the inventor of the improvement cannot manufacture his own invention, it also holds that the inventor of the original article has absolutely no right to the idea. The second inventor is simply limitated by the necessity of having but a single market for his invention.

Many instances could be cited where original patents were practically inoperative without the later patents that brought them from a state of partial perfection to the full bloom of technical maturity. Bell's first telephone was little more than an interesting laboratory toy utterly incapable of taking on even limitated commercial application. It was the Berlinger microphone, the improvements of Edison and a dozen other inventors that finally brought the original telephone to a point of perfection where it could assume the burden placed upon it.

The much-contested and finally defeated Selden automobile patent is another case in point. The original patent covered nothing but the barest essentials of a power-driven carriage. Commercially the idea was impossible, and it was entirely the work of men other than Selden or his associates that made the automobile such a reliable mechanism that it could safely be made for general public use.

It usually happens that a basic patent covering some entirely new thought and capable of supplying the impetus for a new industry, as did the patent just referred to, are incapable of technical perfection without the contributions of other inventors. And these later arrivals by no means need to go unpaid or even unsung. Berlinger was paid a handsome sum for his microphone, and men in the automobile industry like Kettering, who developed the first practical self-starter, have carved off large slices of wealth from the industries which they served.

Before leaving this chapter the writer again wishes to impress the inventor with the fact that the Government has but

little interest in him as an individual. If he can produce some socially useful article, it will reward him with a complete monopoly, provided he can prove that his idea is new, and even at this point the Patent Office officials practically move heaven and earth to prove that the idea is not new. This may sound a bit discouraging and even unfair, but it will be seen that the more and better the Patent Office attempts to prove that an idea is not new, the stronger will be the resulting patent.

The search and effort to prove that an idea is old does not necessarily begin and end in the Patent Office records. There is at least one instance where it can be extended to published fiction. The man who first tried to patent a periscope for submarines was politely told that Jules Verne had minutely described such a thing in his book, *Twenty Thousand Leagues Under the Sea.*

The Patent Office divides patents into four different classes, which may be defined as follows:

1. Mechanical
2. Process or art
3. Composition of matter (chemical compounds)
4. Design

Throughout this chapter the student will find several patents covering these classes. It will be advisable to study each patent over carefully so that the nature of the matter covered will be clear.

The largest number of patents taken out have to do with simple or complicated mechanical devices. Usually they are combinations of common mechanical parts assembled to produce a new operation of some sort. A machine developed for a certain purpose for use in a factory would be called a mechanical patent. For instance, a cigarette-making machine would be strictly mechanical and would come under this classification.

# UNITED STATES PATENT OFFICE.

WILLIAM O. HARRIS, OF HUNTSVILLE, ALABAMA.

DRESSING FOR LEATHER AND PAINTED AND VARNISHED SURFACES.

**1,329,968.** Specification of Letters Patent. **Patented Feb. 3, 1920.**

No Drawing. Application filed May 10, 1919. Serial No. 296,192.

*To all whom it may concern:*

Be it known that I, WILLIAM O. HARRIS, a citizen of the United States, residing at Huntsville, in the county of Madison and State of Alabama, have invented certain new and useful Improvements in Dressing for Leather and Painted and Varnished Surfaces, of which the following is a specification.

The invention relates to a compound designed chiefly for application to leather to preserve the same and impart a neat and pleasing finish thereto and which is adapted for use on surfaces coated with paint or varnish. The compound or dressing is of such a nature as not to impair leather or the like when applied thereto and which will not cause the same to check or deteriorate, but which rather will maintain the same in a pliable condition and act as a preservative therefor.

In preparing the compound or dressing the following ingredients are employed in about the proportions stated, namely:—

| | |
|---|---|
| Raw linseed oil | 66% |
| Apple vinegar | 30% |
| Benzin | 3% |
| Amber oil | 1% |

The ingredients are placed in a vessel and thoroughly agitated until a uniform and homogeneous mixture is produced which is then ready for use and may be bottled for market. Amber oil possesses the property of giving a high luster to a surface and is added to the composition for this sole purpose. Benzin is quick drying and causes the dressing to dry rapidly and attain a hard surface which will not collect dust. While the preparation is particularly adapted for leather and as a dressing for the tops of automobiles and vehicles generally it may be advantageously applied to painted and varnished surfaces since it imparts a luster thereto and renews the finish. The preparation is applied to the surface either by means of a brush or cloth and is subsequently briskly rubbed by means of a soft or woolen cloth so as to remove any surplus material and impart a luster and high finish thereto. By reason of the nature of the mixture the surface thus treated will not check or crack and has a new appearance imparted thereto.

What I claim is:—

1. A dressing for leather and painted and varnished surfaces, the same comprising raw linseed oil, apple vinegar, benzin and amber oil.

2. A dressing for leather and painted and varnished surfaces, the same consisting of raw linseed oil, 66%, apple vinegar 30%, benzin 3% and amber oil 1%.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM O. HARRIS.

Witnesses:
ADDISON WHITE,
V. B. WHITE.

A COMPOSITION OF MATTER PATENT

It might be well to mention here, however, that many mechanical devices of a complicated nature require a number of patents to complete their protection. Some complicated machines involve so many new and original features that it is necessary to cover each one with a separate patent.

Basic patents are the strongest, and every alert inventor tries to obtain a basic patent if he can possibly do so. Few basic patents are issued. A basic patent covers an entirely new de-

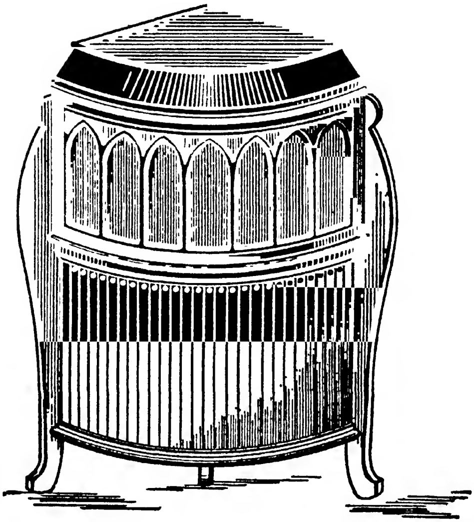
DESIGN.

H. KNAUB.

PHONOGRAPH CABINET.

APPLICATION FILED JAN. 19, 1921.

58,031. Patented May 31, 1921.



WITNESSES
Guy McSpring
B. F. Farney

Inventor
HENRY KNAUB

By Richard B. Owen.
Attorney

DRAWING TO ACCOMPANY A DESIGN PATENT

## UNITED STATES PATENT OFFICE.

HENRY KNAUB, OF RICHMOND, VIRGINIA.

DESIGN FOR A PHONOGRAPH-CABINET.

58,031. Specification for Design. Patented May 31, 1921.

Application filed January 19, 1921. Serial No. 438,451. Term of patent 14 years.

*To all whom it may concern:*

Be it known that I, HENRY KNAUB, a citizen of the United States, residing at Richmond, county of Henrico, State of Virginia, have invented a new, original, and ornamental Design for a Phonograph-Cabinet, of which the following is a specification, reference being had to the accompanying drawing, forming part thereof.

The figure is a perspective view of a phonograph cabinet, showing my new design.

I claim:

The ornamental design for a phonograph cabinet as shown.

HENRY KNAUB.

Witnesses:
HERBERT C. ALLEN,
EMICH U. GYLLENBAND.

A DESIGN PATENT

velopment or art. Edison's electric light patent was basic. It was not an improvement on any known device and it involved basic principles that were not known theretofore. Basic patents usually cover a new application of some physical, chemical, or electrical law. Such patents, once obtained, are very strong and offer maximum protection, although the Patent Office does not call them basic when it issues them.

Patents are granted that cover only processes. A process is seldom developed, however, that can be covered by a single patent. The actual process itself can be covered by a patent, but it is invariably necessary to apply for a number of patents on special machinery and devices that are necessary in the process and that have been developed with the process. The student will find a process patent attached, and he will obtain a good understanding of this particular kind of patent by reading it carefully. A process may be mechanical, electrical, or chemical.

Patents may also cover new compositions of matter. Sometimes a new composition of matter necessitates a new process,

and the process would be patented with the new composition of matter.

A patent may be obtained to protect a certain design, either ornamental or mechanical. Design patents have been very clearly defined by Judge Townsend of the Circuit Court of Appeals for the Second Circuit, who describes them as follows:

"Patents for designs are intended to apply on methods of ornamentation, in which the utility depends upon the pleasing effect imparted to the eye and not on any new function. Design patents refer to appearance, not utility. Their object is to encourage works of art and decorations which appeal to the eye, to the aesthetic emotions, to the beautiful."

# CHAPTER IV

## PATENTABLE AND UNPATENTABLE INVENTIONS

THERE are very distinct limitations as to what can and cannot be patented. A patentable idea must first possess novelty, and this is a Patent-Office term taken to mean "newness." An invention must also be useful and operable. In short, it must possess a fair degree of practicability and be capable of doing what it was designed to do. Our patent law also insists that the invention cannot be injurious to public morals or health. With the exception of perpetual-motion machines, any *new* idea not coming within the above classifications can be patented. Indeed, the patent law does not state in so many words that a perpetual-motion machine cannot be patented; but if the term "useful art" is properly interpreted, the perpetual-motion machine will be found wanting. It is not operable, and therefore not patentable, and the Patent Office will not accept the application for such a patent.

The student inventor will do well to read an actual excerpt from the United States patent law:

U. S. Revised Statutes, Title LX, Sec. 4886. Any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvements thereof not known or used by others in this country before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof, or more than two years prior to his application, and not in public use or on sale in this country for

more than two years prior to his application, unless the same is proved to have been abandoned, may, upon payment of the fees required by law, and other due proceeding had, obtain a patent therefor.

This is bold and plain language if the reader will cautiously digest it. Yet, in the face of such terms and conditions, many perfectly ridiculous and often wild inventions are patented yearly. After all, our patent law and the interpretation that it receives is not infallible, and the Office is often guilty of granting claims in connection with an idea that will not function. A casual thumbing through one of the weekly issues of the *Official Gazette* will be likely to bring to light one or more silly ideas. Not only that, but it will also reveal ideas that have very slim chances of successful operation.

Patent Office examiners are human, and we have human failure here as in every other branch of the Government. One of the most outstanding examples of this sort of failure was had in connection with a mechanism for aiming large guns. The idea had been *tested* and *approved* by the Coast Artillery Board, the Field Artillery Board, and the Chief Orientation Officer of the A.E.F.; but the Patent Office examiner did not agree with these official bodies and he ruled that the machine would not function as the inventor had claimed. This ruling was made three times and the whole affair was inexcusably grotesque. This and many other cases have shown that oftentimes it is very difficult to obtain unopposed protection for a new and valuable invention.

The Patent Office draws a very fine distinction between combinations of elements and mere aggregations. The first are patentable and the second are not. The mere aggregation of known parts or elements which operate in the old way does not

involve invention. This combination of known elements must produce an entirely new result if the machine or device is to receive the prize of monopoly.

A court decision that has become more or less known among patent attorneys stated: "Invention consists of the conception of a function and the selection of means whereby the function can be operatively carried out." These are words to ponder, for they will help the student inventor to obtain a clear conception of the true nature of patentable ideas. Inasmuch as the discovery of natural laws does not involve the "conception of a function," these laws cannot be patented. However, if they are turned to practical use through the medium of some practical device, the device can be protected.

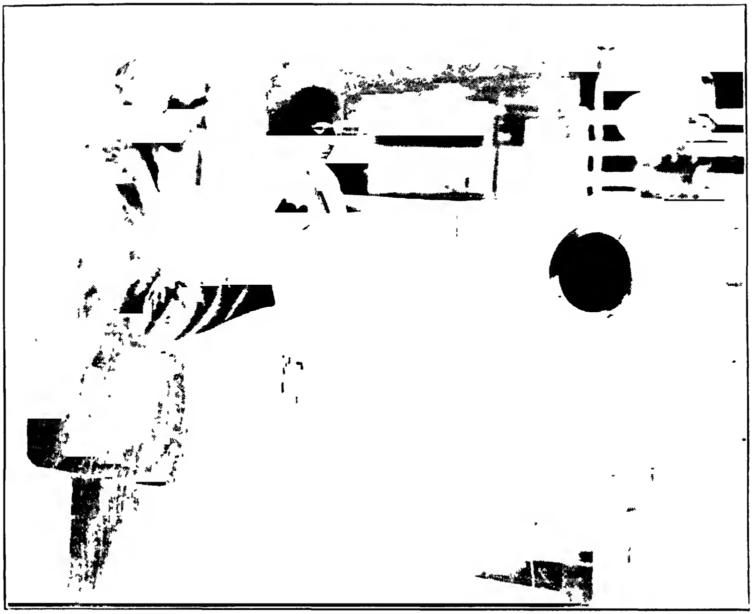
That a thing is novel or that a thing is useful is not enough to bring the reward of patent protection. Invention must be involved, and by this is meant that the inventor is called upon to display more inventive ability and skill than would be expected of the average person. He does not have to know *why* his device works. To know *how* it works is quite sufficient, especially if the inventor is apt at describing this "how." Mere complexity, complication, or intricacy is not proof of invention. Indeed, direct simplicity is to be sought; the accomplishment of a given result by an absolute minimum of parts. This indeed is the highest form of invention and ingenuity, and is so recognized by the experts of the Patent Office. After all, the device should possess the possibilities of offering maximum social usefulness, and unnecessarily complicated machinery will not do this. As a matter of proven fact, it is rather dangerous from a legal standpoint for an inventor to place elements of questionable use on his invention. At times this makes the matter of infringement rather easy. The infringer need only

eliminate some superfluous part, even though the main function of the device is preserved. A court might rule that the patent was not violated.

A new finish or greater perfection is not patentable unless that perfection involves invention in the way of improvement patents. The mere extension of an application does not involve patentability either. If a harvesting machine was patented for hay, its use for harvesting wheat or cotton would involve no novelty. Nor would the mere changing of the size of the machine or the addition of parts, if those parts did not alter the basic functioning of the device, make patentable improvements. Here the would-be inventor would be dealing with mere *equivalents* that would produce the same result or approximately the same result.

If an inventor can make one new part perform the function of several old ones, however, he has earned the right of protection for his idea. Such ideas are of benefit to society because they permit machines to be made with less cost and thereby have commercial attraction. Fewer parts usually mean greater efficiency and less cost for repairs. Merely to dispense with a part without affecting the functioning of the machine is quite another matter. In cases where this is found to be possible, it merely shows weak invention in the first place; for if the first inventor had been on his toes, he would have put his idea through this "process of elimination" before he applied for his patent.

It has been said previously that inventions that would be injurious to public health or morals are not patentable. Perhaps a little elaboration of this point will help the student to gain a clearer meaning of these stipulations. One could not obtain a patent on a gambling machine, for instance, because gambling machines are used illegally and are thought to corrupt the morals of those who do use them. If a man invented a



PRACTICAL RESULTS IN TELEVISION

Nipkow, a German inventor, laid down the principles of television back in 1884, but it was 1920 before the elements involved had been perfected to a point where something akin to practical results could be had. Here was a perfect example of the inventor thinking ahead of his time. Such cases merit admiration, but they do not result in financial reward. Nipkow never received a penny for his contribution.

machine to break jail and admitted the purpose of the invention, he could not obtain a patent, nor could the inventor of a device intended for use in the home concoction of morphine or cocaine. In such rulings the public welfare has to be considered above all, whether or not true invention is involved. Indeed the conception could be a masterpiece of ingenuity and still be beyond the scope of a patent.

This chapter does not set down law. It merely outlines past and current interpretations of law, and what has been said is generally true. However, one never knows what a court decision or a Patent Office ruling will be, and the inventor might easily come upon cases where it would appear that what has been said here is inaccurate. In treating a subject of this nature there is always left a residue of unpredictable matter that must be attributed to the human element. We do have certain precedents in patent law that have held for many years, but that does not mean that they will hold forever. Human progress must be considered. We learn to live and to think differently and, we hope, with greater justice to all concerned.

# CHAPTER V

## CONDUCTING PRELIMINARY INVESTIGATIONS

THERE are certain sources of information and data that are of importance to every inventor and that should be consulted before any decision is made concerning new ventures. Too many inventors rush into things without mature consideration; indeed, without any forethought at all. They appear to lose sight of the fact that inventing is a business and a profession, and that each new venture must be carefully weighed to determine whether or not it holds possibilities of profit. After all, an investment has to be made, an investment of time, worry, money, and sometimes anguish. A business man does not rush in to buy a big bill of goods until he is sure of his market, his margin of profit, his advertising costs, and other factors. The inventor will do well to act likewise and to view each venture as a business proposition to be put through at minimum cost, with a minimum waste of time, and with a weather eye on eventual profits. Too many men rush into a piece of research or development half primed and only vaguely conscious of the ultimate outcome.

Every idea is but the small end of the wedge and the first great question that arises and *must* be answered will be, "Is the idea new?" It makes little difference how clever, how ingenious, or how subtle the idea is, for we have several million other thinking and at times clever countrymen who invent things. Furthermore, we have no less than two million patents

already granted and on file at the Patent Office, with twenty thousand or more pending. At times ideas come to mind that at first blush would appear to be utterly beyond anticipation in any form. But what about the two million patents on file and the millions that appear in the patent files of the other great industrial nations of the world? Any new idea rests upon dangerous ground until it is proven beyond a question of doubt that it has a legal right to live. It may be stolen property!

The writer has in mind a case coming within his own experience that happened very recently in connection with a self-ejecting ice-cube tray that he had thought about. He would almost have staked his life on the fact that it was new and valid, but even in the face of this conviction he exercised his caution and had a search made in the files of the United States Patent Office. This search brought to light a perfect anticipation of the idea that had been protected several years back. In a sense it was a lucky find. It saved work, it saved money and, above all, it saved that ultimate, crushing blow of defeat.

Hence the first step in the development of any idea must be a search of the United States Patent Office conducted by an expert. A novice will not do. The cross-reference index of our Patent Office is now so complicated and so intricate that only a person with adequate training should be entrusted with the task of digging deeply into the records. A poor search is very apt to be worse than no search at all, permitting, as it does, the inventor to proceed with the perfection of an idea that has been anticipated. A search, to mean anything, must be conducted in as perfect a manner as is humanly possible.

Searches are performed by patent attorneys and by a few others with special training for this sort of work. There is the preliminary search and the validity search, the former being a mere casual perusal of the files, while the latter is an ex-

haustive study of all available records. Preliminary searches cost anywhere from five to ten dollars; validity searches may run from twenty-five to one hundred dollars, and even more in special cases.

It often happens that a mere preliminary search will show whether or not an idea has been anticipated, and the inventor will do well to subscribe to this sort of search first. If he finds that his idea has been thought out before, he has spent only ten or fifteen dollars at the most. If, however, this search does not unearth a pertinent reference (each patent pertinent to a given case is called a reference) he can subscribe to a validity search, which will make practically sure that his idea belongs to him. Well enough should not be left alone, and the true inventor is anxious and ready to bring to light any reference that will have a bearing on the patentability of his own conception. Good business dictates this procedure, no matter how distasteful it may be or how disappointing it may turn out in the long run. After all, our own patent laws state that the man who has the idea *first* is the rightful owner, and the late arrival is worse than no arrival at all.

Some of our more wary inventors who have established themselves and who have a little more than the average amount of money often have an entire "art" sent to them from the Patent Office. By an "art" is meant all patents that have ever been filed on one particular subject. Each subject or classification is called an art by the Patent Office and by patent counsel. Thus we have the razor blade art, the pencil art, the typewriter art, etc. The matter filed under the classification of arts like the typewriter, adding machine, locomotive, and other highly developed fields, is so voluminous that it would be a very costly matter to bring it out in its entirety. Then, too, it would be found that in the case of many of the older and more important

patents covering key developments, the supply would be exhausted and the patents would be out of print. This necessitates photo copying and other expense and delays that most inventors do not like to experience.

In the case of the larger arts, it is often desirable to have some particular phase of the art examined and bought in its entirety. For instance, an inventor might want the entire file in connection with locomotive valve gears. It might amount to four or five hundred references, and each patent copy would cost ten cents. Thus forty or fifty dollars would have to be expended on references alone. Some arts have but a few copies, and while a search is being made it is often advisable to do a complete job whether or not all of the patents involved are pertinent. The study of a complete art often gives the inventor new ideas and new methods of approaching old problems. On the whole, it turns out to be mentally stimulating and very much worth the effort of examining each and every patent. In the case of the less voluminous files, an excellent bird's-eye view is obtained which encompasses everything that has been done previously.

Copies of patents can be obtained without a search of the records only in case the actual patent numbers are known. In such cases the copies will be mailed at a cost of ten cents each if the numbers and the remittance are sent to the Superintendent of Documents, Government Printing Office, Washington, D. C.

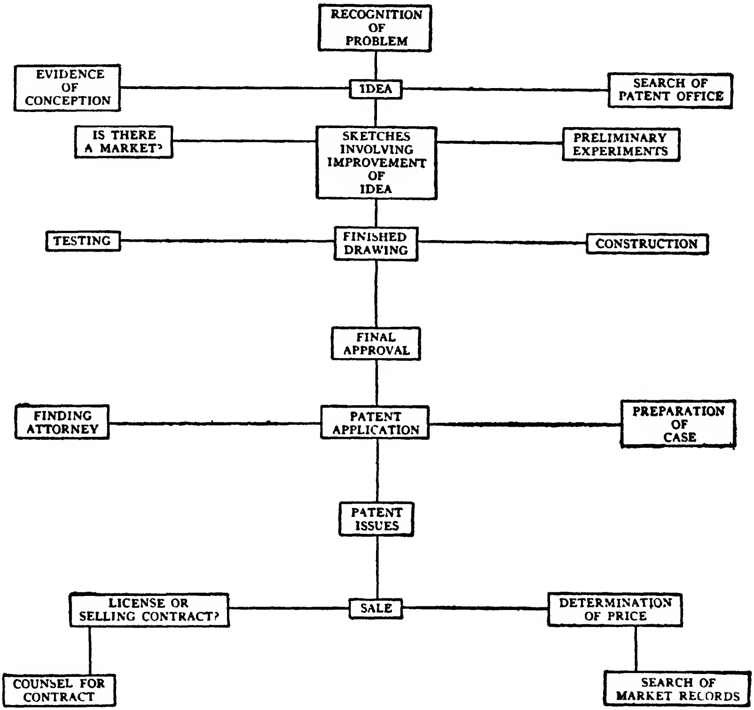
Not all new ideas are patented, even though they might have been announced in technical publications. Such announcement prevents later applicants at the Patent Office from obtaining patent rights in his country. There is a classical case on record which occurred some years ago when a playing-card company practically established a monopoly by a patent covering the printing of the card characters in the upper left-hand and lower

right-hand corners of the cards. It was a perfectly obvious idea, so obvious, indeed, that one of the competing concerns decided that somebody must have thought of it before, even though the patent offices of the world contained no reference to it. A man was sent to Europe and he immediately began a systematic search of all of the great museums. His patience was rewarded in Spain where he came upon a deck of playing cards that had been printed several centuries ago with the card characters placed in precisely the same positions. The evidence was made known, and no more trouble was had from the owner of the United States Patent.

The inventor and research worker living in a large city is especially favored with research facilities in the local library, where complete files of most of the national technical journals are preserved. These files are usually bounded and provided with an index. If the index cannot be found, the investigator may turn to that well-known and very useful work, the *Periodical Reference,* which is published yearly and which contains in a proper index the title of all articles published in all of the American publications. The writer recently had occasion to acquaint himself with the thoroughness and accuracy of this guide in a search for material in connection with photo-electric cells. He brought to light articles by the score, some of them from new and fresh sources that he did not know existed. Each reference gives the name of the publication in which the article appeared, the date, and the author, together with the page number.

If an inventor is working in a strange field, he must know that he is placing himself in competition with men who have spent a lifetime trying to improve their art. No effort to conduct an investigation into this field can therefore be too painstaking or thorough because, above all, the new-comer must

THE EVOLUTION OF AN IDEA




make sure that he is not chasing rainbows. A week spent in earnest investigation might save a year of hard labor—hard and useless labor.

Should an inventor wish to obtain very special information on a highly technical subject, he might find that his local library could be of no assistance to him even though he had accumulated his references. In such cases the Congressional Library at Washington can be appealed to, and it may be found that

some of the services in connection with this branch of governmental activity can be engaged for a small sum of money. Copies of the articles desired may be obtained in this way. The Engineering Societies Library in New York City also has such services for out-of-town people, and the costs barely cover the actual labor and expense involved.

As an inventor continues this sort of investigation, he will be amazed in the manner in which his idea will take form and grow. The information that he uncovers feeds his mind, stimulates his imagination. Even though he might find that his first idea was not new, he may have a second thought that will completely outrank the first one. To succeed, an inventor must live with his idea and exercise the highest form of concentration that he can muster. He needs facts, figures, and data for the grist of his mill, and the more he submerges himself in the activities of other men, the more opportunity he will have to polish and perfect his idea, until it finally emerges devoid of all of the mistakes and shortcomings that have marred its forerunners.

The mere fact that a field is new to a man does not necessarily mean that he will fail in his effort, even though he is thrown into direct competition with men who know more about the work than he does. Perhaps these men have grown old and stale. Perhaps they are so close to the trees that they can no longer see the forest, and a fresh viewpoint will swoop down upon a problem and consume it with glowing passion. It has been done before, it will be done many times in the future. But let no mistake be made about the preparation that is necessary in such conquests. A sudden inspiration does not succeed once in a thousand times. Every inventor must be an informed man. If a man is blindfolded, he might hit the target the first time; but the chances are a million to one that he will miss it completely.

# CHAPTER VI

## WHAT AN INVENTOR SHOULD KNOW ABOUT MECHANICS

THIS chapter can provide the reader with nothing but the barest fundamentals of the science of mechanics; but inasmuch as ninety-five patents out of every one hundred rest solidly on these fundamentals, it is important that the worker know something about them. Practically every electrical invention, for instance, calls for a knowledge of mechanical principles, for the reason that very few of its elements will be purely electrical in nature. The designer of even so highly specialized an electrical instrument as a relay would be hopelessly incompetent if he did not know something about the essentials of mechanics. Even the chemical engineer has a thorough training in these matters, and precious few industrial arts can be separated from the mechanical foundation of our material, workaday world.

The reader is cautioned that this chapter cannot be looked upon as a "course" in mechanics. It is merely asked to serve the modest purpose of an introduction that is to be followed with further study. For this reason the writer has used as terse and as unornamental a style as possible, it being his object to set down the facts in a clear and concise manner; and if the reader will continue his study with a book on mechanical movements, he will find himself in possession of a very useful knowledge that will help solve many otherwise difficult problems.

Matter is defined as that which occupies space and it exists

in three states: liquid, solid, and gaseous. Therefore, the science of mechanics is divided into the mechanics of solids, liquids, and gases. Owing to the fact that the mechanics of liquids and gases are more or less remote from the realm of practical mechanics, the discussion of these particular phases will end here. The mechanics of solids will constitute the subject-matter of the ensuing paragraphs.

There are certain terms which are constantly used in connection with the science of mechanics. These terms are energy, power, force, and work, and the student is cautioned not to be too presumptuous in deciding the real meaning of these terms. It is a common mistake to think that they are analogous. In ordinary language they are, but in the language of science they take on a special and definite meaning.

Energy is present in six different forms: kinetic, potential, electric, chemical, heat, and magnetic. It can be readily transformed from one form into another. Through the agency of the electric battery, chemical energy is transformed into electric energy, and the potential energy in a coiled spring is changed to kinetic energy when the spring is released.

Energy is never transformed from one form to another without a serious loss. In the steam-electric power plant, for instance, the loss of energy through transformation is enormous. The chemical energy released by the combustion of the coal under a boiler is converted into kinetic energy through the medium of steam and the steam engine or turbine. This kinetic energy is again transformed into electric energy through the medium of the generator. Through this series of transformations, but a small percentage of the original chemical energy released by the burning coal is available in the form of useful electric energy at the terminals of the generator.

The energy that is lost in transformation is only lost in so

far as man is unable to recover it. Energy, like matter, is absolutely indestructible. It cannot be destroyed in any known manner. The law covering this phase of science is known as the law of the conservation of energy. When one ball strikes another on the billiard table, most of the kinetic energy possessed by the first ball is imparted to the second one. The sudden impact causes a certain amount of the original energy to be transformed into heat. A part is also lost in the production of sound waves.

In the study of theoretical mechanics, force is recognized as that which tends to produce or modify motion, and it is usually measured in pounds. A force always has a certain direction, point of application, and magnitude.

Work, although closely related to force, has a different meaning. Work is performed when a force produces motion in overcoming resistance. Work really consists of two elements, force and motion. Force may be applied, but, unless motion is produced, no work results. In calculating work done, the magnitude of the force applied is measured in pounds, and the distance moved in feet. The term foot-pound has evolved from this method of calculation. The foot-pound is the product of force (in pounds) and distance (in feet). Work = force × distance.

Power is the rate of doing work. It is usually expressed in foot-pounds per minute or second, and it can be defined as the product of force and distance divided by time. If 33,000 pounds are raised one foot in one minute, one horsepower is expended. To calculate power, it is necessary to divide the number of foot-pounds of work done in one minute by 33,000. Thus, if 66,000 pounds are raised one foot in one minute, 66,000 ÷ 33,000 = 2 horsepower.

Velocity is the rate of motion or the distance covered divided by time. It is generally expressed in feet per minute or second,

and the calculation of velocity does not include force or weight. If a body moves 6,000 feet in 6 minutes, its velocity will be 1,000 feet per minute.

One of the most important phases of theoretical mechanics is the application of force to matter. In Figure 1, the body *A* has been moved from *B* to *C* in the direction of the arrow. The applied force is represented by the straight line. The arrow gives the direction, the length of the line represents the magnitude, and the end of the line the point at which the force was

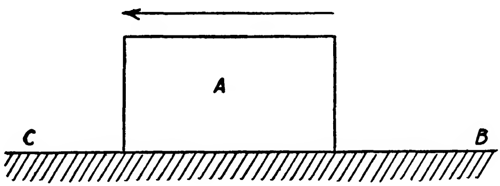



FIG. 1. A SIMPLE GRAPHICAL REPRESENTATION OF FORCE APPLIED TO MATTER

applied. It will be understood that the longer the line, the greater the magnitude or value of the applied force, because it would require a greater force to move the body *A* one inch than it would to move it a half inch. The graphical representation of forces is a great aid to the study of applied forces.

In Figure 2 it will be seen that two forces have been applied to the body *A*, each in an opposite direction. This is a case of

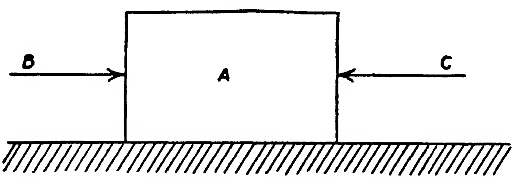



FIG. 2. A SIMPLE REPRESENTATION OF TWO OPPOSING FORCES APPLIED TO MATTER

opposed forces. If the forces $B$ and $C$ are equal, the body $A$ will not move. If one force is greater than the other, the body will move a distance equivalent to the difference in the applied forces. This is in accordance with the law of the conservation of energy.

If two forces act in the same direction, the value of the resultant force will be equal to their sum. This is shown in Figure 3. The force $B$ is greater than $C$, but it will be seen that they are both applied in the same direction. These are

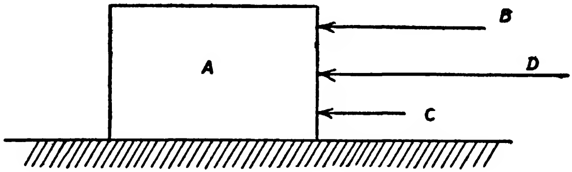



FIG. 3. RESULTANT OF TWO FORCES ACTING IN THE SAME DIRECTION

The application of two forces, $B$ and $C$, to a body bring about a resultant force, $D$.

called parallel forces. The line $D$ represents the resultant force, the sum of the forces $B$ and $C$. If two forces act on a body in the same direction, the resultant force can be represented by the line as shown in Figure 4.

Owing to its relationship to mechanics, the study of force and its application is an important one. Every part of a machine moves as a result of applied force, and many important illustrations of applied force can be made by use of the lever. The lever is a solid rod mounted or resting upon a point called the "fulcrum." The lever shown in Figure 5 is called a lever of the first class. This lever is divided into three parts, the fulcrum, already mentioned, the weight arm, and the power arm. It will be noticed that the power arm is that portion to

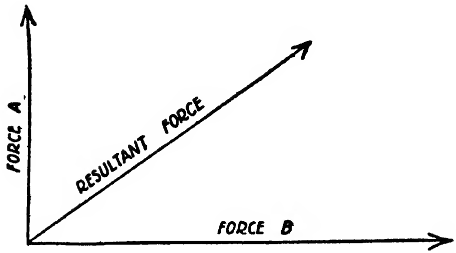



FIG. 4. RESULTANT OF TWO FORCES ACTING IN DIVERGENT DIRECTIONS

Two forces, *A* and *B*, applied in the manner illustrated, will bring about a resultant force acting in the direction of the arrow.

which the force is applied, while the weight arm is that arm supporting the weight. The second-class lever has the weight between the fulcrum and the force, as shown in Figure 6. A lever of the third class has the force applied between the weight and the fulcrum. This is shown in Figure 7. The fundamental law of the lever is the same for all classes.

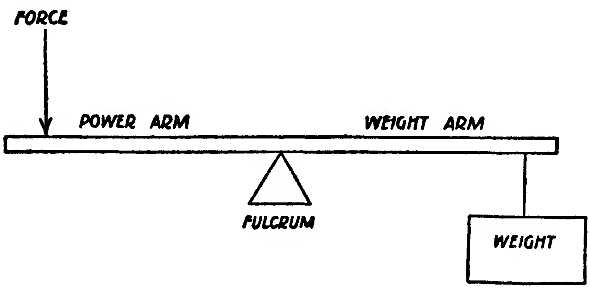



FIG. 5. A LEVER OF THE FIRST CLASS

The fulcrum is between the force and the weight. Such levers play a very important part in mechanics.

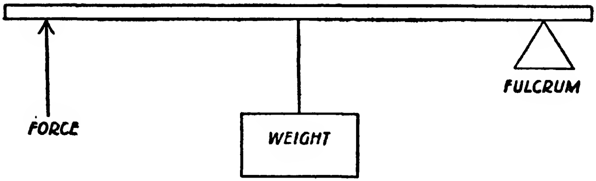



Fig. 6. A lever of the second class

The weight is between the force and the fulcrum. Hardly a machine exists that does not in some way involve the principle of the lever.

From illustration (Figure 5) it will be seen that the greater the distance between the fulcrum and the applied power, and the shorter the distance between the fulcrum and the weight, the more powerful the lever will be. The power of the lever is practically infinite. Aristotle was one of the first of the early scientists to recognize the principles underlying the application of this great power.

To carry the explanation of the lever further, reference is made to Figure 8. A force acting upon a body tends to produce motion either in a straight or circular line. The first is called a motion of translation, the second a motion of rotation.

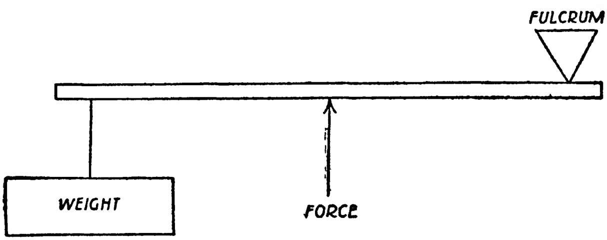



Fig. 7. A lever of the third class

The force is applied between the weight and the fulcrum.

The lever in Figure 8 is pivoted at $A$, and any force acting upon it (except one which would pass through the center of the pivot as indicated by the line $B$) would tend to produce a rotary motion. The tendency toward rotational movement will depend upon two factors, i. e., the magnitude of the force and its exact distance from the pivot when measured along a line that will be at exact angles to the line of action of the force.

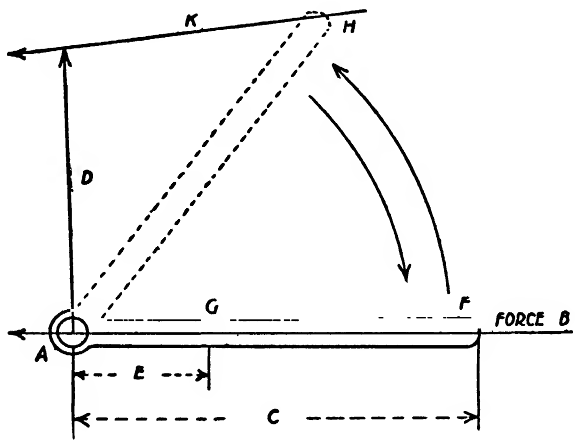



FIG. 8. THE PRINCIPLE OF MOMENTS

A graphic analysis of the various forces that can be applied to a simple lever and the effects that will be brought about.

A line, measured at right angles to the force, in case of the force passing through the center of the pivot, would not involve the lever at all, and therefore a rotary movement would not be produced. If a force of 10 lbs. is applied to the lever at $F$, its moment (moment in mechanics means the measure of the turning effect of a force which has a tendency to produce a rotary motion) will be greater than it would be if the force were applied at the point $G$. This is in accordance with

the law stating that the rotary motion or moment will depend upon (1) the magnitude of the force and (2) its distance from the pivot or center of motion. It will be noticed that the distance *E* is less than the distance *C* from the center of the lever; therefore the rotary effect of the force acting at point *G* will be less than that acting at point *F*. If the lever is in the position indicated by the dotted lines and a force of 10 lbs. is acting upon it in the direction *K*, it will be found that the effective distance *D* is much less than the distance *C* when the lever was in the other position. For this reason the force, although the same in both cases, would not be as effective.

In each of the cases mentioned, it will be seen that the actual leverage is equal to the distance of the lines *D, E,* and *C*. These lines are called the "lever arms of the moment." The moment can be calculated by multiplying the force by the perpendicular distance from the axis to the line representing the direction of the force. If the distance from *F* to the center of the axis or pivot *A* is 2½ ft. and the force applied to the point *F* 10 lbs., the result in foot-pounds or the moment will be:

$$2.5 \times 10 = 25 \text{ foot-pounds.}$$

If a force *A* (see Figure 9) acted upon a wheel, the wheel would rotate and function in the manner of a continuous lever. It will be seen that the tendency to rotate will be greater if the force is applied at the periphery. If a force *B* were applied, the tendency to rotate would be less. In the case of the

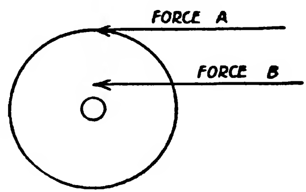



FIG. 9. THE RELATION OF LEVERAGE TO ROTATION

How two forces applied to different parts of a wheel will act to move the wheel. The force *A* will have a greater tendency to do this than will *B* because of the greater leverage which it will work through.

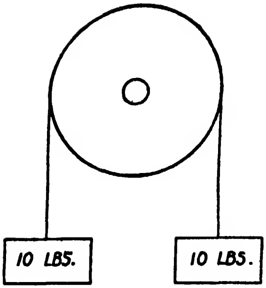



FIG. 10. A MECHANICAL SYSTEM IN EQUILIBRIUM

In such cases no movement of the wheel will result.

wheel shown in Figure 10, no rotation will be noticed, owing to the fact that the whole system is in perfect equilibrium. It will also be seen that the wheel functions as a lever; the center acting as the fulcrum and the two sides as the weight and power arms. The weight is equal to the power and therefore no motion is produced.

A series of connected pulleys or wheels is called a train, and the wheel which imparts the motion is called the driver. Since a wheel functions as a continuous lever, a train of wheels will act as a system of compound levers. In Figure 11, the rope *A*, and hence the force applied at the end, will move through twice the distance traveled by the weight *B*. Therefore, the weight can be equal to twice the force applied at the end of the rope. If another pulley is added to the system, a weight three times greater than the applied force can be lifted, but the distance traveled by the weight will be one third of that traveled by the force acting at the end of the rope. With a system of seven pulleys, a weight seven times greater than the applied force can be lifted theo-

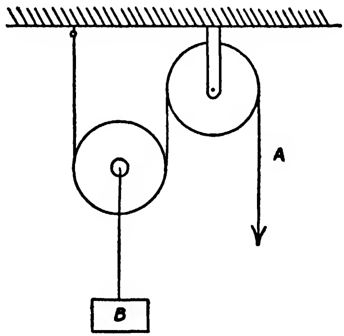



FIG. 11. A SIMPLE PROBLEM INVOLVING PULLEYS

Here the rope *A* will move twice the distance traveled by the weight *B*. Therefore the weight can theoretically be equal to twice the force applied.

retically if the frictional losses are not considered. In the above example, the weight moves through a distance that is one seventh of that traveled by the force.

With a system of pulleys, one man can lift many times his own weight. If a system of six pulleys is used and the force applied at the end of the rope is equivalent to 50 lbs., it will be possible to lift $6 \times 50$ or 300 lbs. If the end of the rope or the force passes through 60 ft., the weight will be lifted $\frac{1}{6}$ of 60 or $60 \div 6 = 10$ ft.

Another device that takes an important part in the science of mechanics is the inclined plane. The inclined plane will be seen by referring to *A*, Figure 12. A plane that is at an angle

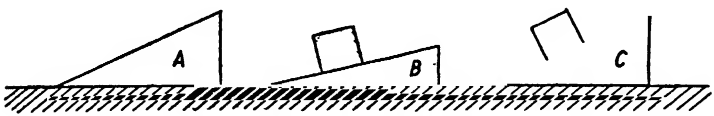



FIG. 12. THE INCLINED PLANE

Every mechanic should know something about the action of bodies on inclined planes.

(except a right angle) to a horizontal plane is called an inclined plane. It will be understood that a smaller force is required to move a given weight up an inclined plane than to move it perpendicularly. The nearer the inclined plane approaches the perpendicular the greater the force necessary. The weight on the inclined plane at *B*, Figure 12, could be moved by a smaller force than would be necessary to move the same weight at *C*, where the angle is greater. It must also be understood that the same amount of power (not force) is required to move the weight in both instances, provided the perpendicular distances are the same. The force in moving

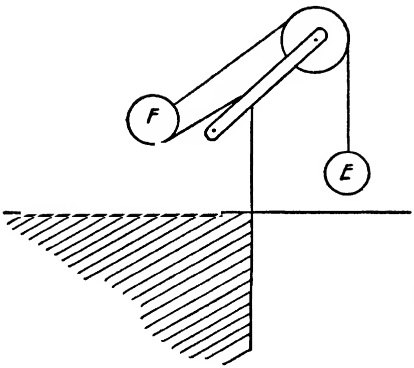



FIG. 13. MECHANICAL USE OF THE INCLINED PLANE

The relationships between the weights $F$ and $E$ should be understood by the student inventor. Such factors as these often enter into the design of even the most elementary machinery.

the weight up angle $B$ will act through a greater length of time, but the actual power (which is force × time) will be the same as that required to lift the weight on angle $C$.

To prove the mechanical advantage of the inclined plane, attention is called to Figure 13. The weight $E$ is able to lift the weight $F$ up the inclined plane, although the weight $E$ is smaller than the weight being lifted. The more the inclined plane approaches the perpendicular, the greater the weight $E$ must be to lift the weight $F$.

The wedge is an example of the inclined plane. Its action is illustrated in Figure 14. By the aid of a wedge a man is able to raise a tremendous weight. It must be constantly borne in mind that the same power is necessary to raise a given weight

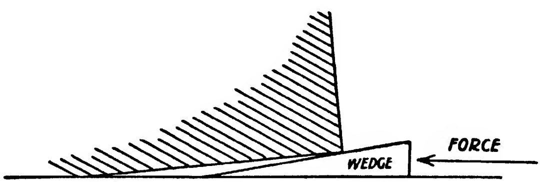



FIG. 14. THE WEDGE

The wedge amounts to a practical application of the inclined plane through the medium of which small forces applied over comparatively long periods of time can be used to lift large weights.

a given distance. A small force applied for a long time is equal to a great force applied for a short time. A man may spend half a day driving wedges under a large block of steel to lift it 10 inches. A steam-driven hoist of sufficient horse-power could lift the same block the same distance in a few seconds.

The screw is an example of an inclined plane, and great force can be applied by its aid. The jack, Figure 15, is an application of the screw or inclined plane, and with it a single man can lift tremendous weights. The jack is really a combination of inclined plane and the lever. The longer the lever of the jack is, and the less the pitch of the threads on the screw, the greater its lifting power will be.

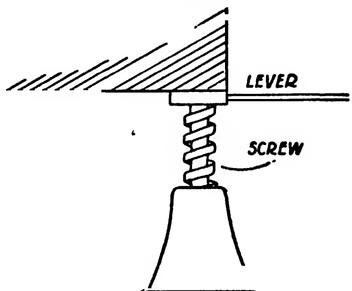



FIG. 15. THE SCREW

A screw is a more or less continuous inclined plane. By its action great weights may be lifted through the application of small forces over extended periods of time.

Friction is another factor which enters into mechanical design, and it should be thoroughly understood. Friction is the resistance to motion caused by one body sliding or rolling over another. Friction is divided into two classes: kinetic, caused by moving bodies, and static, or the friction between two bodies at rest. Friction is caused by tiny depressions and projections of one body interlocking with those of another. The more mechanically perfect the surface of a body is, the less friction it will offer to a body sliding or rolling over it. The resistance to motion offered by friction consumes a great deal of power.

We will perhaps be better able to understand the relation between motion and friction if we refer to Figure 16. The

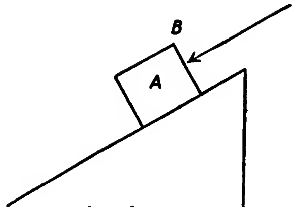



FIG. 16. THE EFFECT OF FRICTION

A body at rest on an inclined plane will not move unless its weight or the force acting upon it is great enough to overcome friction.

body *A* is at rest on the inclined plane. The static friction between the surface of the inclined plane and the body is great enough to prevent the body from sliding down the plane. If the plane is at the proper angle, the body will gain motion and slide down the plane if a force is applied at *B*. This proves that the static friction, or the friction of rest, is greater than the kinetic friction or friction of motion.

If a lubricant is introduced between the body and the surface of the plane, the friction will be greatly reduced. The lubricant finds its way into the pores of the surfaces and fills them up. As a result of this, the friction is no longer between the body and the plane but between the surface of the body and the lubricant, and the surface of the plane and the lubricant.

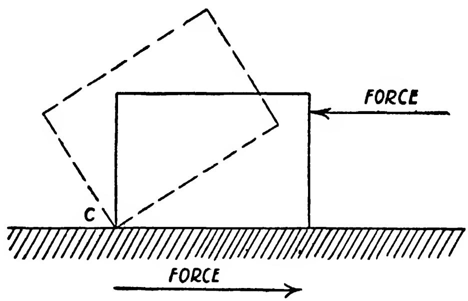



FIG. 17. FRICTIONAL RESISTANCE

A sudden, powerful force applied in the manner shown above will have a tendency to revolve the body that it strikes.

If a body is at rest on a horizontal plane as shown in Figure 17, and a force is applied in the direction indicated, the frictional resistance will cause a counter-force to act in the opposite direction to the

force that is producing the motion. This counter-force will depend entirely upon the surfaces in contact. If the surfaces are smooth, the counter-force or negative force will be small. If the applied force is not greater than the negative force, no motion will be produced. If the resistance is high enough and the applied force great enough, the body will tend to rotate by mounting upon its edge *C*. The edge or point *C* will then act as the center of a wheel.

To lift a weight, its reactive force must be overcome. If the weight in Figure 18 is lifted from its position, two forces must be present, one acting upward and one downward. If the upward force is great enough, the weight will be lifted.

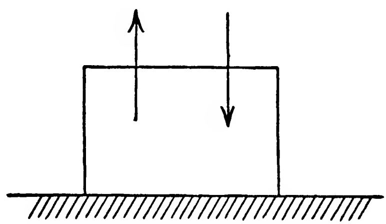


FIG. 18. GRAVITATIONAL FORCE

This diagram represents the force of action and reaction. In lifting a body the force acting downward (gravity) must be less than the force tending to lift the body.

It will be well to consider briefly gravity at this point. Gravity may be defined as that attractive force which exists between the earth and all bodies upon the earth. The weight of a body is due to the gravitational force that is pulling it down. Gravitational force tends to pull or move a body in a direction toward the center of the earth.

The attractive force of gravity is the same regardless of the weight of the body. Some bodies are so "light" that the resistance of the air partly overcomes gravitational force. A falling piece of paper will not move as rapidly as a piece of iron, but the force pulling it is just as great. It is a mistake to believe that the greater the mass of a body, the more rapidly it will fall. The

greater the mass of a body, the greater the work that will have to be performed by the gravitational force in pulling it toward the center of the earth. Therefore, a small mass will fall just as rapidly as a great mass.

If a circle is drawn on cardboard with a compass and then cut out as in *A*, Figure 19, the center of the circle will be the center of gravity. This can be proved by mounting the circle upon a pin and placing it in a vertical position. The disc will

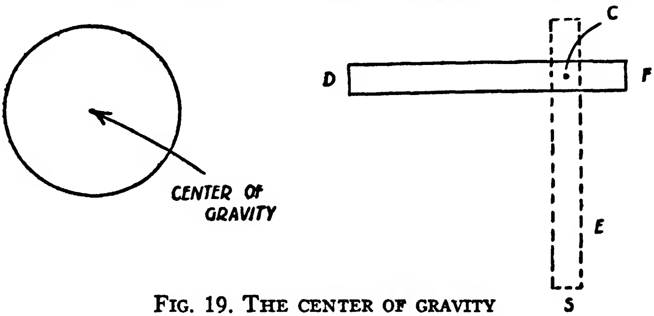



FIG. 19. THE CENTER OF GRAVITY

The center of a circle is usually the center of gravity. In most systems this center of gravity must be calculated or determined by experiment.

not move from the position in which it is placed—that is, it will not move under the influence of gravity. This is not because gravity fails to exert its force, but on account of the fact that the force is just as great on one side as it is on the other. If the piece *B* was mounted upon a pin at *C*, it would drop to the position shown at *E* because the gravitational force on the side *D* would be greater than on the side *F*.

The center of gravity may be defined as that point in a body which is at the center of its magnitude. If a one-foot rule is balanced on a knife-edge at its six-inch point, the rule is said to be in equilibrium or balance. In the study of theoretical mechanics it is assumed that gravity acts as a single force

at the center of gravity in a body, but the body is really drawn down by a number of forces, acting at different points.

The center of gravity in simple geometrical figures can be readily found, provided the body is perfectly homogeneous. The center of gravity of the various figures illustrated in Figure 20 would be found by drawing the lines shown.

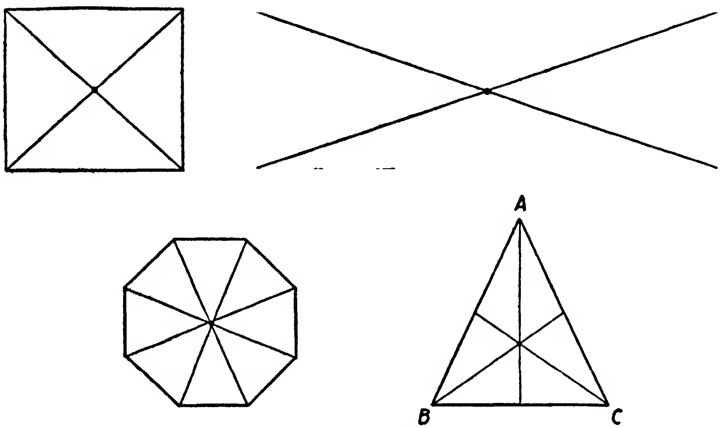



FIG. 20. FINDING THE CENTER OF GRAVITY

How the centers of gravity are found for various shapes. It is presumed that the materials going to make up these forms are homogeneous and that thickness does not vary.

Inertia and momentum are also two important terms which must be understood by the inventor. Many believe that momentum is just the opposite of inertia, but this is not a fact. Newton's first law of motion states that a body at rest tends to remain at rest and a body in motion, moving in a straight line, tends to remain in motion unless it is acted upon by another force. It may be said that inertia is that property possessed by a body that tends to resist motion when at rest and resist any force that tends to produce rest when the body is in

motion. A baseball would remain in motion forever if it was not acted upon by two other forces aside from the one which produced its motion. The resistance of the air it is passing through gives rise to a force that is acting in the opposite direction to the force that produced the motion. The force of gravity is also pulling the ball to earth.

In determining the momentum of a body, mass and velocity must be considered. Momentum is really a product of mass and velocity. The greater the mass and velocity of a body, the greater its momentum will be. A body with a great velocity may possess as much momentum as a larger body moving at less speed. A shell with a mass $1/8000$ that of an express train has a striking force twice as great as that of an express train traveling 45 miles per hour. This is because of the immensely higher speed of the projectile.

Attention will again be directed to the inclined plane and its application to the screw. It will be understood that the screw is merely a continued inclined plane about a cylinder. The consideration of the screw at this time will be limited to an understanding of the terms used in connection with it.

The pitch of a thread or screw is the distance between two adjacent threads when measured from center to center. The pitch is measured in the fractions of an inch. If the threads are $1/2$ inch apart, the pitch is merely called "12" in practice, and the same expression is used for all fractions. In other words the pitch of a thread is the distance it will advance in one complete revolution. If the pitch is 16, the screw will advance $1/16$ of an inch in one revolution.

The lead of a screw is the distance it will advance in one complete revolution, and it must not be confused with pitch. In the case of a single thread such as that shown at *A*, Figure 21, the pitch and the lead will be the same, but in the case of

a double thread (*B*) the lead will be twice as much as the pitch. At *C*, the lead is three times as great as the pitch. A single thread is one in which the lead is equal to the pitch. A double thread is one in which the lead is twice the pitch, and a triple thread has a lead three times the pitch.

The root diameter of a screw is the diameter measured at the bottom of the thread. The external diameter is the outside measurement over the top of the thread or at the widest point.

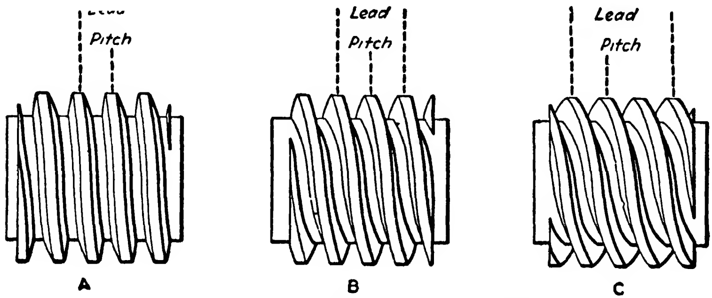



FIG. 21. PITCH AND LEAD OF SCREWS

A study of these drawings will make the difference between pitch and lead very clear.

It is quite necessary that the student gain some knowledge of gears, as they play an important part in mechanics. Gears are used entirely for the transmission of power and motion. The illustration, Figure 22, shows how motion and power can be transmitted by the use of two small wheels. The motion is transmitted by the wheel *A* (the driver) to *B*, by friction. Such a method is unsatisfactory, since a large portion of the power and motion will be lost through slippage. To overcome their loss a better drive can be produced by cutting teeth in the perimeter of the wheels. The teeth on both wheels can be cut exactly the same and they will then fit into each other, the

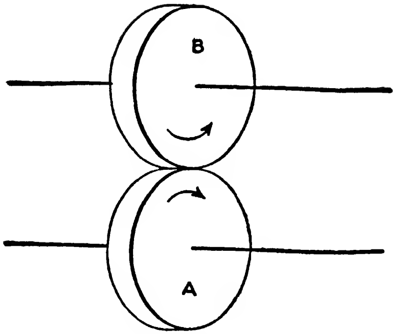



FIG. 22. USING FRICTION TO TRANSMIT POWER

How the transmission of power is brought about between two shafts by means of friction. Barring losses through this source, the speed of the wheel driven would equal that of the driver, provided the diameters of the wheels were the same.

teeth of one fitting into the depressions of the other. When this is done, the gears are said to be "in mesh."

By again referring to Figure 22, it will be noticed that for every revolution the wheel *A* makes, *B* will also make one. (This is assuming that there are no losses through friction.) This is because the two wheels are of the same size. If *B* were twice the size of *A*, as illustrated in Figure 23, the speed of *B* would be one half that of *A*. It will be seen that *A* must revolve twice for every revolution made by *B*. If the circumference of *B* were five times that of *A*, the speed would be one fifth as great. The student will now understand that two or more gears acting together will function as a system of continuous levers.

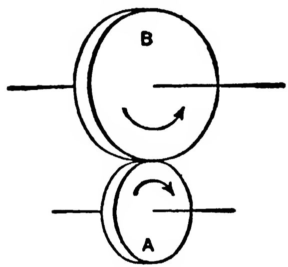



FIG. 23. THE RELATION OF GEARS TO SPEED

Speeds of predetermined values can be had by using gears of certain diameters. Here *B* drives *A* at double the speed of *B* if *B* has twice the diameter of *A*.

Gear wheels must be very scientifically made and accurately cut. The various terms employed in connection with gear wheels will be made clear by reference to Figure 24. The pitch or diameter of a gear

wheel is really the diameter of a plain cylinder without teeth which the gear may be considered as replacing. This theoretical or imaginary boundary is represented by the dotted line. The circular pitch of a gear wheel is the distance from the exact center of one tooth to the center of the next one at the point where the pitch line or circle passes through. This is shown clearly at Figure 24.

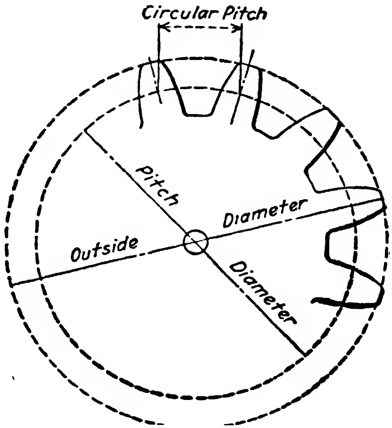



FIG. 24. THE MATHEMATICAL FACTORS IN A GEAR

These factors must be known and understood if the proper choice of gears is to be made.

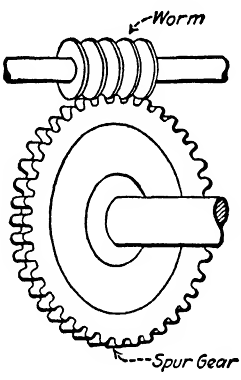



FIG. 25. THE WORM AND SPUR GEAR

When maximum power at slow speed is needed, the inventor turns to the worm and spur gear.

Worm gears are screws which mesh with gear wheels especially designed for this use. Such an arrangement for the transmission of power or motion will be better understood by referring to Figure 25. It will be seen that the spur must be driven by the worm, as it is impossible for the gear to turn a worm with the pitch shown. The number of revolutions of the worm to produce one complete revolution of the gear will depend upon the pitch of the worm when considered as a screw. Such arrangements as that shown in Figure 25

are used when low speed and maximum transmission of power are wanted. Gear wheels, to work efficiently and without undue noise or wear, must mesh properly; their axes of rotation must be a specific distance apart, depending upon the pitch circle.

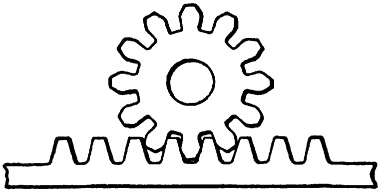


FIG. 26. THE RACK AND PINION

This type of gear is used to bring about the movement of special parts that must move in a line.

Figure 26 depicts another arrangement to produce motion or transmit power by the use of gears. The small gear (called a pinion when used in this way) is so mounted that its teeth mesh with the teeth on a straight piece. The straight piece is called a rack. The speed of the rack for a given speed of the pinion will depend entirely upon the pitch diameter of the pinion.

Motion is transmitted at right angles by the use of bevel, miter, or crown gears. The teeth in miter gears are mounted at 90 degrees so that when they mesh, the shafts upon which

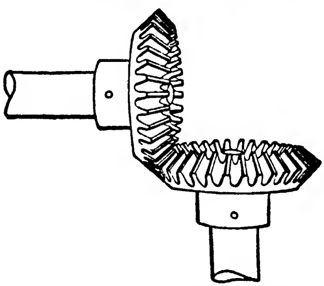


FIG. 27. THE MITRE GEAR

The mitre gear is one used to bring about movement between parts that are placed at a 90 degree angle. These gears are beveled at 45 degrees.

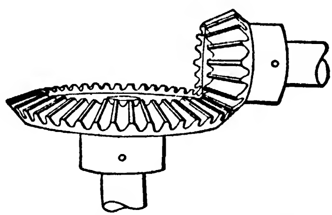


FIG. 28. THE BEVEL GEAR

Although used for the same purpose as the mitre gear, the bevel gear differs in the fact that the teeth are arranged at a less acute angle.

they are mounted will be at right angles. The arrangement is illustrated at Figure 27. Bevel gears as shown in Figure 28. Crown gears are used many times to replace bevel and miter gears. The use of the crown gear is shown in Figure 29.

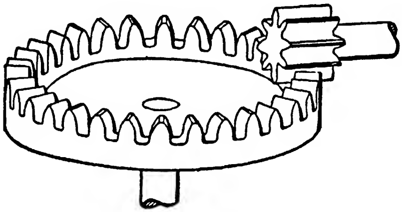


FIG. 29. THE CROWN GEAR

While it is not a very efficient transmitter of power, the crown gear is sometimes used to bring about the movement between small parts of a machine.

# CHAPTER VII

## WHAT AN INVENTOR SHOULD KNOW ABOUT CHEMISTRY

CHEMISTRY is a very important subject. Every inventor should know something about it, since chemical processes often enter into inventive work. If Goodyear had not known something about chemistry, he would not have succeeded in vulcanizing rubber; and if Edison had not known something about this subject, we would not have the Edison storage battery. A deep knowledge of the subject is not necessary to start with. If the outstanding fundamentals are learned, the inventor will be provided with enough knowledge to give him sort of a "chemical sense" and to carry him further into the subject if his work warrants it.

The study of chemistry is generally started by an understanding of the words "element" and "compound." Scientists have found that this world of ours, as great as it is, is merely composed of ninety odd elements or basic substances. There is a great difference between an element and a compound. If a chemist takes a quantity of water to analyze, he finds that he is able to break the water up into two gases, i. e., hydrogen and oxygen. These two gases, when separated, resist any further attempts to be "divided." That is, they are basic substances—they are elements. A compound, then, is a combination of elements. Water is a compound because it is composed of oxygen and hydrogen. Iron is an element because it is composed of nothing but iron—the chemist is not able to break up the iron into any other constituents.

It was stated before that there are but ninety odd elements in the whole world. However, these ninety odd elements combine in different proportions to form many thousand compounds. The physical and chemical properties and characteristics of the compounds formed are entirely different from those of the individual elements which go to make up the compound. For instance, water is a liquid but its constituents are the gases hydrogen and oxygen.

Some of the elements are gaseous, some solid, and a few liquid. The list of chemical elements—elements of the whole world—follows:

| | Symbol | Combining or Atomic Weight |
|---|---|---|
| Aluminum | Al | 27.1 |
| Antimony | Sb | 120.2 |
| Argon | A | 39.88 |
| Arsenic | As | 74.96 |
| Barium | Ba | 137.37 |
| Bismuth | Bi | 208.0 |
| Boron | B | 11.0 |
| Bromine | Br | 79.92 |
| Cadmium | Cd | 112.40 |
| Calcium | Ca | 40.07 |
| Carbon | C | 12.00 |
| Cerium | Ce | 140.25 |
| Cesium | Cs | 132.81 |
| Chlorine | Cl | 35.46 |
| Chromium | Cr | 52.0 |
| Cobalt | Co | 58.97 |
| Columbium | Bc | 93.5 |
| Copper | Cu | 63.57 |
| Dysprosium | Dy | 162.5 |
| Erbium | Er | 167.7 |
| Europium | Eu | 152.0 |
| Fluorine | F | 19.0 |
| Gadolinium | Gd | 157.3 |
| Gallium | Ga | 69.9 |
| Germanium | Ge | 72.6 |

| | Symbol | Combining or Atomic Weight |
|---|---|---|
| Glucinum | Gl | 9.1 |
| Gold | Au | 197.2 |
| Helium | He | 3.99 |
| Hydrogen | H | 1.008 |
| Indium | In | 114.8 |
| Iodine | I | 126.92 |
| Iridium | Ir | 193.1 |
| Iron | Fe | 55.84 |
| Krypton | Kr | 82.92 |
| Lanthanum | La | 139.0 |
| Lead | Pb | 207.10 |
| Litecium | Lu | 174.0 |
| Lithium | Li | 6.94 |
| Magnesium | Mg | 24.32 |
| Manganese | Mn | 54.93 |
| Mercury | Hg | 200.6 |
| Molybdenum | Mo | 96.0 |
| Neodynium | Nd | 144.3 |
| Neon | Ne | 20.2 |
| Nickel | Ni | 58.68 |
| Nitrogen | N | 14.1 |
| Nitron (radium emanation) | Nt | 222.4 |
| Osmium | Os | 190 9 |
| Oxygen | O | 16.00 |
| Palladium | Pd | 106.7 |
| Phosphorus | P | 31.04 |
| Platinum | Pt | 195.2 |
| Potassium | K | 39.10 |
| Praseodymium | Pr | 140.6 |
| Radium | Ra | 226.4 |
| Rhodium | Rh | 102 9 |
| Rubidium | Rb | 85.45 |
| Ruthenium | Ru | 101.7 |
| Samarium | Sa | 150.4 |
| Scandium | Sc | 44.1 |
| Selenium | Se | 79.2 |
| Silicon | Si | 28.3 |
| Silver | Ag | 107.88 |
| Sodium | Na | 23.00 |
| Strontium | Sr | 87.63 |

| | Symbol | Combining or Atomic Weight |
|---|---|---|
| Sulphur | S | 32.07 |
| Tantalum | Ta | 181.5 |
| Tellurium | Te | 127.5 |
| Terbium | Tb | 159.2 |
| Thallium | Tl | 204.0 |
| Thorium | Th | 232.4 |
| Thulium | Tm | 168.5 |
| Tin | Sn | 119.0 |
| Titanium | Ti | 48.01 |
| Tungsten | W | 184.0 |
| Uranium | U | 238.5 |
| Vanadium | V | 51.0 |
| Xenon | Xe | 130.2 |
| Ytterbium | Yb | 172.0 |
| Yttrium | Yt | 89.0 |
| Zinc | Zn | 65.37 |
| Zirconium | Zr | 90.6 |

After each of the elements in the above list will be found a letter or symbol which chemists use in place of writing out the entire word. In place of writing out the word "hydrogen," merely the first letter, H, is used. This may be called the shorthand method of chemical expression, and the symbol for all of the common elements should be memorized by the student. Upon referring to the list it will also be seen that the symbol for some of the elements is composed of two letters, and that these letters in no way correspond to the letters in the word. Sodium is represented by the letters Na, and Mercury by Hg. Inasmuch as many of the names of elements start with the same letter, this letter's use for each element would lead to confusion. Therefore, the first two letters of the Latin name are used. Cu, which represents copper, is taken from the Latin *cuprum*. In some cases only the first letter of the Latin name is employed.

Before going further with the study of chemistry it will be

well to understand the terms molecule, atom, and electron. The molecule is composed of two or more atoms, usually of different elements. Water, which is composed of hydrogen and oxygen, has a molecule made up of two atoms of hydrogen and one atom of oxygen. Molecules, however, are not always associated with compounds. There are a few elements which have a molecule which is made up of two or more of their own atoms.

Molecules are extremely small. In fact, they are far beyond the range of the most powerful optical instruments of magnification. They are generally measured in millionths of an inch. Some molecules are composed of two atoms and some of many hundred atoms. Of course, those containing many hundred atoms are much larger than those with a smaller number.

If molecules are made up of atoms, and molecules are measured in millionths of an inch, it can readily be appreciated that the atom must be a much smaller particle. This is quite true. The reader will understand that compounds do not have atoms in the sense that an element has atoms. True, the ultimate constituent of a compound is the atom, but owing to the fact that the atoms are grouped together to form molecules, chemists are inclined to regard a compound as being made up of molecules rather than atoms. This will be made more clear later.

The reader is now aware of the fact that a molecule is composed of two or more atoms and that the atom is that infinitesimal particle that goes to make up elements. Thus, we have the atom of sodium, the atom of potassium, the atom of copper, etc. We cannot say, however, that we have the atom of water because water is made of two elements in combination. In place of atom, the term molecule is used. A molecule of water is pictured diagrammatically in Figure 30. It will be

seen that the atom of oxygen is really larger than the atom of hydrogen. It will also be seen that there are two atoms of hydrogen to one atom of oxygen. Upon referring to the list of elements, it will be noticed that the atomic weight of oxygen is greater than the atomic weight of hydrogen. Owing to the fact that atoms are made up of the same particles, electrons, which will be considered later, it will be understood that the elements with the larger atomic weights must have the larger atoms. The chemical expression for water is written $H_2O$. This means that there are two atoms of hydrogen and one atom of oxygen. The figure 2 after the H signifies the number of hydrogen atoms in the compound.

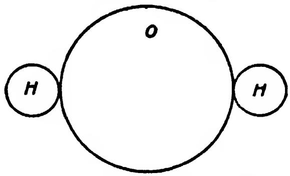



FIG. 30. THE CHEMICAL STRUCTURE OF WATER

A highly simplified diagram showing hydrogen associated with oxygen in the formation of the water molecule.

At this point we are ready to consider that last and ultimate constituent of matter, the electron. The electron is really a comparatively recent discovery of science. It is responsible for the "electron theory," which would seem to reduce all material phenomena to purely electrical terms.

The electron is absolutely the smallest particle. It goes to make up atoms. Each atom has an identity. We have atoms of copper, iron, etc. All electrons are the same. Just as atoms in various numbers form molecules, electrons in various numbers form atoms. However, we cannot draw a distinct parallel between the two classes.

The electron is really a unit of negative electricity. It has a mass of $1/1700$ths of an atom of hydrogen, which, as a glance at the list of chemical elements will show, is the smallest and lightest atom. It may confuse many readers to think some-

what vaguely of an electron being a "unit of negative electricity." However, this is about the best explanation that can be given. In a strict sense, the electron cannot be considered as matter. The single electron we must accept as a unit of mysterious "something" that we have called negative electricity.

Atoms are composed of various numbers of electrons, and each atom has a specified number. Thus, each element has a certain identity.

Are we to picture the atom as being composed of a specified number of electrons arranged in a haphazard manner? Not so. In fact, we know that "like charges of electricity repel one another and unlike charges attract one another." With this fact in mind, then, how can we think of our hypothetical atom as being made up of electrons when these electrons are negative units of electricity and when negative charges repel one another? If this were the case, our hypothetical atom of electricity would soon be dissipated.

The electron theory describes an atom as a particle composed of a definite number of electrons or negatively charged units revolving about a sphere of positive electricity. Of course, this "sphere of positive electricity," or proton, as it is called, is just as much a mystery to us as the electron itself. Nevertheless, it furnishes us with a reasonable hypothesis. If unlike charges of electricity attract one another, then the sphere of positive electricity, which forms the nucleus of the atom, will cause the electrons, which are units of negative electricity, to remain in proximity to the nucleus, which is made up of protons.

A very crude diagram which is intended to represent at least the arrangement of the electrons in an atom is shown in Figure 31. It must be remembered that every atom of oxygen,

for instance, has exactly the same number of electrons. This is true of all the atoms of the different elements. From this we see that each chemical element is different because it contains a certain number of electrons in its atom. All matter must be regarded as being composed of electrons; these electrons are grouped into atoms, and the atoms into molecules.

From the above information we assume, then, that each

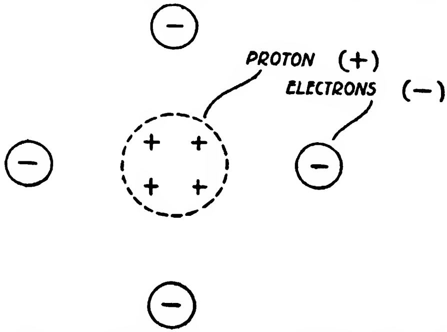



FIG. 31. THE ELECTRICAL CONSTITUTION OF ATOMS

Electrical balance is brought about in atoms by the proper distribution of the charges on protons and electrons. The protons form the nucleus, while the electrons arrange themselves about the nucleus in regular patterns.

atom is in an electrically neutral condition. If the positive charge is strong enough to bring about an electrical equilibrium, this would be the case. Let us, for the moment, maintain that this is the case. We will picture a group of electrons held about the nucleus of an atom with neither the positive electricity of the nucleus nor the negative electricity of the electrons predominating. We will say that we have an electrical equilibrium. What if one electron were to escape from the atom in some way? The equalization of charges, or the equilibrium, would then be destroyed and the positive charge

would predominate. Again, we can imagine one hypothetical atom coming in contact with another atom, the second atom losing an electron which is immediately picked up by the first atom. Investigation has proven that this interchange of electrons actually does take place.

Let us review what we have said concerning the electron theory a little more thoughtfully. The importance of the theory to present-day science justifies this. If we were to arrange all of the elements in the list shown previously according to their atomic weight, starting with hydrogen as number one because it is the lightest, and giving the second place to the next heaviest, and so on, part of the list would be as follows: Hydrogen 1; Helium 2; Lithium 3; Glucinum 4; Boron 5; Carbon 6; Nitrogen 7; Oxygen 8; Fluorine 9; Neon 10; Sodium 11; Magnesium 12; Aluminum 13; Silicon 14; Phosphorus 15; Sulphur 16; Chlorine 17; Argon 18; Potassium 19; Calcium 20; Scandium 21; Titanium 22; Vanadium 23; Chromium 24; Manganese 25; Iron 26; Cobalt 27; Nickel 28; Copper 29; Zinc 30; etc. Here the atoms are arranged according to their atomic weight, so if copper, for instance, occupies the twenty-ninth place, we will call 29 the atomic number of copper. Thus, the atomic number of carbon will be 6, that of Fluorine 9, etc. We must remember not to confuse this atomic number with atomic weight, although it is related to it in a certain respect.

A young English scientist recently promulgated the theory that the atomic number corresponds with the electro-positive charges that form the nucleus of any atom. In other words, if the atomic number corresponds to the number of units of positive electricity that go to make up the atomic nuclei, there must be one electron or negative unit for each positive unit. Thus, the hydrogen atom contains one electron, the

helium atom two electrons, lithium three electrons and so on through the entire list.

By themselves, we remember, electrons would repel each other, but in the presence of positive charges, they show a disposition to arrange themselves in definite groups or configurations. If hydrogen has but one electron, how does it conform to any particular systematic arrangement? This does not necessarily interfere with the hypothesis we have in mind. We can picture the hydrogen atom as being made up of one charge of positive electricity and one electron. The lone electron which goes to make up the hydrogen atom is ever trying to form a pair, and therefore the atoms group into molecules and hydrogen is one of the elements that has a molecule.

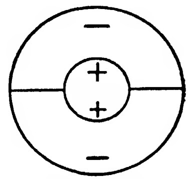


FIG. 32. ELECTRICAL EQUILIBRIUM IN ATOMS

Equilibrium of an electrical nature is brought about in atoms by an equal number of positive and negative charges, the positive charges being carried by the protons and the negative charges by the electrons.

Helium has the atomic number 2. We understand that this element has two positive charges to form its nucleus and therefore two electrons to counter-balance these charges. The atom of helium can be pictured crudely as shown in Figure 32.

The + marks represent the positive charges and the – marks the electrons. Here we have an ideal atom with the electrons ideally arranged and electrically balanced. As a result, helium is an extremely inactive element. Chemists call it "inert." It shows absolutely no disposition to enter into chemical relationship with any other element. Why should it? It is electrically balanced—it wants neither to gain nor to lose electrons.

Neon, although nine places from helium in the list of atomic numbers, is next to it in point of stability or chemical in-

activity. It is another of the inert elements. Neon has ten electrons in its atom. We remarked some time ago that the elements tended to arrange themselves systematically about the positive charges of a nucleus. Here we have ten electrons. Let us see how they would arrange themselves, in the light of our theory. The first two electrons arrange themselves about the nucleus the same way as the two electrons in the atom of helium. The remainder, in the words of the theory, show a disposition to group themselves into octets. Thus, each electron has a little "cell" of its own, we may say. In the atom of neon, we have a pair of electrons and an octet, all balanced, all filling every available space, and as a result, there is no chemical activity to neon. Like helium it is inert. Neon has an ideally arranged atom.

In this way the electron theory accounts for chemical inactivity. Fluorine has the atomic number 9. We can readily understand that the nine electrons of fluorine cannot arrange themselves as did the ten electrons contained in the atom of neon. We do know, however, that they will *tend* to arrange themselves in the same way. All electrons tend to assume the same general arrangement. We assume that the nine electrons form themselves in the same way. There is one space in the octet, however, that remains unfilled. This empty space accounts for the extreme chemical activity of fluorine, as we shall soon see. Fluorine has two electrons about its nucleus just as neon does. The other seven electrons are in the outer shell or octet, leaving one space unoccupied—one electron is lacking to make the octet complete. In this condition, the atom of fluorine is not favored with a stable electrical

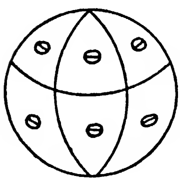


FIG. 33. THE PATTERN OF AN ATOM

How the electrons in a complicated atom tend to arrange themselves in regular patterns.

condition. It needs one more electron to make it stable. The cumulative striving of its seven outside electrons to form an octet is so great as to give the element fluorine an intense chemical activity. In fact, fluorine is a very active element. We might say that its atom has an intense appetite for one more electron to complete its octet. We can also understand that the atom of fluorine is electro-positive in nature, as it is constantly in need of one more electron to bring about an electrical equilibrium.

There are many other elements like fluorine. In fact, none of the elements, aside from the inert gases—helium, neon, krypton, xenon, and argon—has its outer shell satisfied or occupied, and each is always trying to make pairs or octets to complete its arrangement and to bring about an electrical equilibrium. *This is the basis of all chemical combination and activity.* What arrangement do the electrons make in atoms with more than ten? The electrons over ten form another octet or shell over the first one. If there are enough electrons, the third and even the fourth octet or shell is formed. The outside shell or octet of all the atoms, aside from those of the inert gases, is incomplete. Therefore, all of the elements are chemically active aside from the inert gases. We must look upon chemical action as an interchange of electrons.

Having covered the cause of chemical reaction, we are now in a position to understand chemical formulae and expression. We now know that water is expressed chemically $H_2O$. This signifies that there are two atoms of hydrogen and one of oxygen in the water molecule. The reaction between oxygen and hydrogen can be expressed in this way:

$$2H + O = H_2O$$

This means that hydrogen plus oxygen equals water. It must

be understood here that all chemical elements do not react when brought together. Some elements are very inert or chemically inactive. In other words, they have very stable atoms in perfect electrical equilibrium. Thus, the gas helium is extremely inert. In fact, it is not possible to make it combine with any other known element. We must also remember that a chemical reaction can take place between compounds as well as between elements. When two elements or compounds react with one another, it is said to be due to "chemical affinity." However, we now know that this chemical affinity is really electrical in nature.

Let us see what would happen if we were to drop a small piece of the element sodium (Na) into water ($H_2O$). If this is done, a very energetic reaction to sodium hydroxide takes place. The result can be represented by the formula:

$$2Na + 2H_2O = 2NaOH + H_2$$

If we study this carefully, we can account for all of the elements that entered into the reaction. We can also see that we have made, or caused to be made, a new compound. The NaOH is called sodium hydroxide (the word hydroxide is produced by a combination of hydrogen and oxygen). The resulting molecule, which makes up the mass of the sodium hydroxide, is composed of one atom of sodium, one of hydrogen, and one of oxygen. We must remember, however, that we had two atoms of hydrogen when we started out. What became of the second one? The + $H_2$ on the end of the chemical expression signifies that the second atom of hydrogen escaped in a free condition. If we were to place a test tube over the sodium immediately after it was placed in the water, we could collect the hydrogen as it left the surface of the water.

The amateur chemist must learn that when two chemical

compounds are placed together and a reaction takes place, each one of the elements that entered into the reaction must be accounted for. Let us place two more substances together and see what happens. This time we will add a small piece of iron (Fe) to hydrochloric acid (HCl). The result can be represented in this way:

$$Fe + 2HCl = FeCl_2 + H_2$$

The result of this chemical reaction is iron chloride and free hydrogen. We can see from this that the iron must have had a greater chemical affinity for the gas chlorine than the hydrogen had. Hence, the metal and the hydrogen merely changed places.

All chemical reactions do not take place at the same rate of speed. When the sodium was placed in water, the reaction took place very rapidly. In fact, if the piece of sodium had been large enough, the reaction would have been so violent, and the heat generated so great, that the hydrogen escaping would have been ignited and an explosion would have resulted. All reactions, however, are not as violent as this one. Some substances take weeks and even months to undergo a tangible reaction. On the other hand, many reactions take place in a remarkably short space of time. The explosion of dynamite takes place in $\frac{1}{24000}$ of a second.

All chemical reactions are not so simple as those illustrated above. The more elements present in any chemical reaction, the more complex it will be. The following reaction is more complicated than those mentioned hitherto:

$$2NaOH + H_2SO_4 = 2H_2O + Na_2SO_4$$

This is the action that results when sodium hydroxide is placed in contact with sulphuric acid. The result is water and sodium sulphate.

When water is frozen, is the change a chemical or physical one? This is a question that must be decided before we go farther. The change of liquid water into ice is entirely physical. That is, no fundamental change has taken place in the molecular arrangement of the water; the change is not a permanent one that gives the water a different chemical nature. A chemical change always produces an entirely new substance. For instance, when coal burns, a white ash is left and nothing remains that resembles the original material.

Chemical action is always accompanied either by the liberation or absorption of heat. When aluminum burns in oxygen, forming aluminum oxide, a terrific heat is produced by the reaction. In other cases, heat is absorbed by the reaction. However, in most cases, heat is liberated. The more rapidly a chemical reaction takes place, the higher the temperature produced will be. In the oxidation of aluminum, as carried out in the Thermit process of welding, a temperature of nearly 5,000 degrees Fahrenheit is produced. In slow chemical reactions that extend over a great length of time, heat is liberated, but not perceptibly. In some cases, there is such a slight rise in temperature that it is almost immeasurable. In every case a specific amount of heat is liberated, and this depends upon the amount of substances or elements that enter into the reaction.

When two chemical elements react to form a compound, they always do so in definite proportions. For instance, when copper burns in oxygen, forming copper oxide, there is always the same proportion by weight of oxygen and copper. The substance, if analyzed, will be found to contain 79.96 percent copper and the rest oxygen. If there is any excess of either one of the two elements present during the reaction, it will remain unchanged. This law holds true throughout the entire

science of chemistry, and it is called the "law of definite proportions." It must be stated as follows: *A pure compound always contains the same elements in constant ratio by weight.*

We are now ready to learn the three different kinds of chemical action. If red oxide of mercury is heated in a test tube over a Bunsen flame, oxygen will be given off and pure metallic mercury will be left in the tube. The application of heat brings about a separation of the elements oxygen and mercury. In other words, a decomposition has taken place and this chemical action is therefore called one of decomposition. We will define a chemical action of decomposition, then, as one in which a compound is divided or broken up into its constituents.

If iron filings are placed in a test tube with powdered sulphur and heated, the mass will gradually change to a black-appearing substance called iron sulphide. This chemical action is said to be one of synthesis or combination—two elements combined to form a new compound.

If a little sodium hydroxide (NaOH) is placed in a test tube containing a solution of copper sulphate (CuSo), a blue precipitate will fall to the bottom of the tube. After this reaction has taken place, there is present in the tube copper hydroxide and sodium sulphate. The sodium changed place with the copper and the copper changed place with the sodium. Such a chemical action is said to be one of exchange or substitution.

When iron reacts with the gas chlorine, a compound known as iron chloride is produced. If copper were to react with the gas in place of iron, we would have copper chloride. In fact, most of the metals will react with chlorine to form what is known as a "chloride" of the particular metal which enters into the reaction. If the metals react with sulphur, sulphates

or sulphides result. If they react with water, hydroxides result. If sodium reacts with the gas nitrogen, a compound known as sodium nitrate is the product of the reaction. Thus, we also have a number of compounds known as nitrates or nitrides. When the word nitrate, sulphate, or chloride is used, we know, then, that the compound mentioned will either contain nitrogen, sulphur, or chlorine. Many of the metals combine with the gas carbon dioxide. The resulting compound is called a carbonate. Thus we have potassium carbonate, sodium carbonate, calcium carbonate, etc. When other elements combine with phosphorus, phosphites are produced. We have sodium phosphate, calcium phosphate and potassium phosphate. The reader, however, should not confuse himself by thinking that all the elements combine with phosphorus, nitrogen, or chlorine to form phosphates, nitrates, or chlorides.

The law of combining weights is a very important part of chemistry. The best we can do in the limited space we have at our disposal is to give the outstanding features of it. Upon referring to the list of elements which appear on pages 73, 74, and 75, we will find the atomic or combining weight written after each element. Thus, after nitrogen we find 14, after oxygen 16, etc. This number, we must remember, represents the weight of each element. By it we are able to ascertain, in a comparative way, the weights of the different elements. We know that hydrogen, which is 1.008, must be much lighter than lead, which is given as 207.10. Now if lead combines with any other element, the weight of the resulting compound will be 207.10 plus the combining or atomic weight of the element that entered into the reaction with the lead. When oxygen and hydrogen combine to form water, we know the formula to be $2H + O = H_2O$. The subscript 2 means that two combining weights (or we may say, atoms) of hydrogen unite with

one combining weight of oxygen. We know that the combining weight of hydrogen is 1.008 and that of oxygen 16. Knowing this, then, we can easily figure the molecular weight of water. We say it is molecular weight because it is the sum of the weights of the atoms contained in the molecule. It is figured in this way: $1.008 \times 2 = 2.016 + 16 = 18.016$ molecular weight of water. When hydrogen combines with the gas chlorine to form hydrogen chloride, the molecular weight of the resulting compound will be 35.46 (chlorine) $+ 1.008 = 36.468$ molecular weight of hydrogen chloride. Hydrogen chloride is expressed chemically by the symbol $HCl$. Here we see that only one combining weight of hydrogen enters into combination with one combining weight of chlorine.

At this point we will consider solution. When ordinary table salt is dissolved in water, we say we have a solution. Solutions play a very important part in chemistry. When a substance is capable of passing into solution we say it is "soluble." Different substances have different degrees of solubility. Some are so backward in this respect that we call them insoluble. Others are extremely soluble. Not only are solids capable of forming solutions, but some gases also. Hydrogen chloride (which is really called hydrochloric acid gas) is very soluble in water, and when in solution it is called hydrochloric acid.

Temperature plays an important part in the phenomena of solutions. In general, it can be said that the higher the temperature of water is, the greater its dissolving powers will be. The higher the temperature of the water, the greater amount of sodium nitrate it will be capable of taking into solution. We may say that for any given temperature a given volume of water will be capable of dissolving a specific amount of any soluble substance.

What would happen if we were to dissolve all of the salt

possible in hot water and then permit the water to cool? Upon cooling, a certain portion of the salt would re-crystallize and precipitate to the bottom of the vessel.

We now come to a consideration of acids and bases. A substance is either acid, base or neutral. Some substances are strongly base, others only slightly so.

Acids have many properties in common by means of which they can be identified. They all taste sour, redden litmus paper, and contain hydrogen as one of their essential constituents. Of course, this does not mean that all compounds containing hydrogen are acid. However, there is no acid that does not contain hydrogen. Another general characteristic of acids is that they liberate hydrogen when they come in contact with magnesium or zinc. In fact, most of the acids liberate hydrogen upon contact with almost any metal. The following shows the reaction caused by bringing zinc in contact with hydrochloric acid:

$$Zn + HCl = ZnCl + H$$

The following is a short list of the more common acids:

| | |
|---|---|
| Hydrochloric acid | $HCl$ |
| Hydrobromic acid | Hbr |
| Hydriodic acid | $HI$ |
| Nitric acid | $HNO_3$ |
| Acetic acid | $HC_2H_3O_2$ |
| Sulphuric acid | $H_2SO_4$ |
| Phosphoric acid | $H_3PO_4$ |
| Oxalic acid | $H_2C_2O_4$ |

Acids manifest their characteristic properties only when dissolved in water or a few other solvents. We may regard an acid, then, as a solution in water. In this way an acid solution can be made of practically any strength by merely adding water.

Bases are a large class of substances that exhibit like properties when dissolved in water. They have a distinct alkaline taste, a soapy feeling, and they all turn red litmus paper blue. They all contain hydrogen and oxygen in what has become known as the "hydroxyl group," which is represented by OH. Bases, like acids, do not exhibit their characteristic properties unless dissolved in water. The common properties of the bases are attributed to the OH or hydroxyl group. Every compound that contains the hydroxyl group is not necessarily a base. The identity is brought about by the action of the substance when dissolved in water.

A substance that is neither an acid nor a base is said to be neutral. It must be understood that we cannot refer to the elements as being either acid or neutral. Elements are all neutral; they exhibit neither the properties of bases nor acids. From the foregoing we find that the chemist divides all substances up into three classes—acids, bases, or neutral.

It would be quite natural to think that when a base is added to an acid, a neutral solution would result. This is exactly what happens. This can be proved by adding hydrochloric acid to a solution of sodium hydroxide in the proper proportion. If this is done, we will find that the resulting solution will neither turn blue litmus paper red nor red litmus paper blue. It has neither an alkaline nor sour taste nor a soapy feeling. It will not evolve hydrogen when it comes in contact with either magnesium or zinc. In fact, the solution exhibits none of the properties common to acids or bases. If the solution is tasted, it will be found to have a distinct salty taste. An outline of the reaction which takes place will account for this:

The resulting product of the reaction is sodium chloride

(NaCl), common table salt. The salt can be obtained by completely evaporating the water by the application of heat. The salt will be left in the receptacle in its usual crystalline form.

All the bases and acids neutralize each other when they come in contact. Of course, the resulting reaction is not the same as the one outlined above. When potassium hydroxide (KOH) and nitric acid ($HNO_3$) are brought together the following reaction takes place:

$$KOH + HNO_3 = H_2O + KNO_3$$

The potassium nitrate ($KNO_3$) is a salt of the metal that formed part of the hydroxide. This is the case in all reactions of this nature; a salt of the metal is always formed.

A list of the common bases is given below:

| | |
|---|---|
| Sodium hydroxide | NaOH |
| Ammonium hydroxide | $NH_4OH$ |
| Potassium hydroxide | KOH |
| Barium hydroxide | $Ba(OH)_2$ |
| Calcium hydroxide | $Ca(OH)_2$ |
| Strontium hydroxide | $Sr(OH)_2$ |

These bases are largely concerned with the general study of chemistry and the student is urged to memorize their formulae as far as possible.

The student has probably often heard the terms organic and inorganic chemistry. To avoid confusion it might be well to make the distinction clear at this point. Organic chemistry is largely the chemistry of the vegetable and animal kingdoms. It is concerned mostly with the elements carbon, nitrogen, hydrogen, and oxygen, which unite in an unending variety of combinations to form many thousand different compounds. The following is a typical organic formula:

$C_2H_5OH$ (ethyl or grain alcohol)

STRUCTURAL MODEL OF AN ORGANIC COMPOUND

How the various atoms of the elements (especially carbon, hydrogen, oxygen, and nitrogen) arrange themselves in the complicated molecules of organic compounds Many such new compounds have been patented, and some of them have brought great sums of money to their inventors

The following is also an organic reaction which shows what takes place when an acid is brought in contact with ethyl alcohol:

$$CH_3COOH + C_2H_5OH = H_2O + CH_3COOC_2H_5$$

It will be very easy to distinguish this reaction from those that we have been considering throughout the chapter. The study of organic chemistry is quite outside the scope of this chapter, which is merely prepared to give the student an insight into inorganic chemistry.

# CHAPTER VIII

## WHAT AN INVENTOR SHOULD KNOW ABOUT ELECTRICITY

ELECTRICITY is a great servant of the inventor and there are few things that an inventor can do without finding it necessary to use a knowledge of mechanics and electricity combined. In fact, every electrical device involves some mechanical principles and, therefore, the two subjects are closely allied. An inventor cannot produce a new electric motor with a knowledge of electricity only. When it came to designing the mechanical parts of the motor such as the bearings and frame, knowledge of mechanics would be necessary. A large percentage of the patents taken out in the last thirty years have covered electrical devices, and yet there is much still to be done.

Electricity is a mystery to the average man, but this should not be so. Everything is a mystery if we do not care to go far enough in studying it. True, we cannot tell what electricity is; but for that matter, we cannot tell what a tiny speck of matter really is. We know how electricity behaves, however; we know exactly what it does under certain conditions. In the study of mechanics the reader became acquainted with certain mechanical laws which are invariably true. There are electrical laws as well as mechanical laws, and electricity obeys these laws without exception.

The writer cannot hope to give a complete course in elec-

tricity, but he can provide the student with a working knowledge that will allow him to go further with the study. He would also like to impress the student with the great importance of electricity, and the possibilities of its application to many fields of invention.

An electric current can be very nicely compared to water flowing through a pipe. Most people have heard of voltage and amperage, and possibly of electrical resistance. What is voltage? What is amperage? What is electrical resistance?

When water flows through a pipe, it meets with a certain amount of resistance. If the pipe is very small, the resistance will be high and it will tend to overcome or reduce the pressure of the water flowing through it. We measure the flow of water in gallons per minute; we use the gallon as a measure of quantity. The water flowing in the pipe must also have a certain pressure back of it or it would not flow. We measure this pressure in pounds per square inch.

Voltage is electrical pressure. It is the driving force that pushes the electric current through a wire or other conductor. Every electric current has a certain definite pressure. The pressure may be high or it may be low. A current may have only two or three volts pushing it through the wire. Quite naturally, this pressure would be more easily overcome by the resistance of the wire than a pressure of 110 volts, or, say, 5,000 volts. At 5,000 volts the pressure is comparatively high.

The amperage of the electrical circuit is the quantity of the current; it is the real working force. Without voltage or pressure there would be no such thing as electric current because there would be nothing to force the amperes through the wire. When a ball rolls down a hill, the force of gravity is pulling it and helping it to overcome resistance. If there were no force acting on the ball, it would not roll. The same is true in

electric current. If there were no such thing as voltage, there would be no current.

Every electrical conductor offers a certain amount of resistance to the passage of the electric current. The amount of resistance offered depends upon several factors. The nature of the conductor is one. Some substances can conduct much more readily than others. For instance, iron wire is a comparatively bad conductor. It allows electricity to pass through it, to be sure, but it does so grudgingly. It tends to hold the current back, to choke it off. Copper wire, on the other hand, has a very low electrical resistance and it allows current to pass very freely. Every substance has a certain capacity to carry electric current.

When a great amount of water is to be delivered in a given time through a very small pipe, high pressure is used. In this way a large volume of water can be delivered through a small passage. If we had a small electric wire through which we wanted to pass a certain amount of current, we should have to adjust the voltage or pressure to a point where it would force the proper amount of current through the wire. If one wanted to use a low pressure and the same amount of current, one would have to use a larger wire.

The resistance of wire is measured in units called ohms. Electric wire has so much resistance per foot. The longer the wire, the greater the resistance. In the case of water one could not expect to use the same pressure in forcing a stream of water through a mile and a half of pipe that would be used in forcing it through 300 feet of pipe. The longer the pipe, the greater the pressure that would have to be employed.

Voltage alone is not the most important thing. High voltage alone is quite useless. The writer has often experimented with

pressures as high as 300,000 volts. However, the amperage was practically nil, and for that reason the 300,000 volts would not have been able to move a toy motor.

When we multiply voltage by amperage we have units that are known as watts. For instance, if an electric motor consumed a current of 10 amperes under a pressure of 100 volts, it would be using 1,000 watts. A watt is $\frac{1}{746}$th of a horsepower. Therefore, in this case, about $1\frac{1}{2}$ hp. of current would be used in driving the motor.

How is electric current generated? There are several ways in which it can be produced. It is generated in large quantities by dynamos. In smaller quantities it is usually generated by electric batteries or cells. An electric cell is shown in Figure 34. This is of the wet type. It contains two elements, copper and zinc, immersed in a chemical solution. A chemical reaction takes place and an electric current is produced. The current depends upon the size of the cell and the voltage depends upon the materials used in the cell. A cell the size of a thimble would have the same voltage as a cell the size of a barrel, but in the latter case the amperage would be very high.

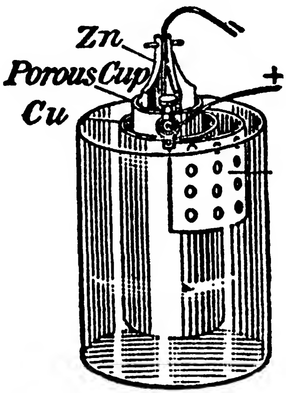



FIG. 34. AN ELECTRIC CELL

Before the dynamo was invented, electric batteries alone were used for the generation of electric current. This was a costly and impractical system. Research replaced the battery or chemical cell with the dynamo and later with the alternator or alternating-current generator.

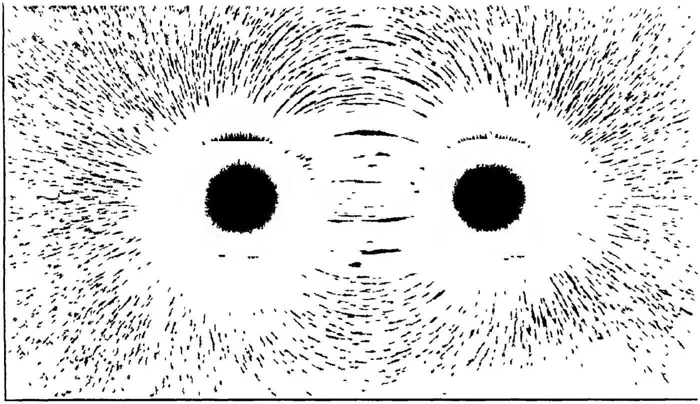
Electricity generated in an electric cell always flows in one direction, from the positive to the negative pole. Positive means of the "higher

potential." If we had two tanks of water connected by a pipe, water from the first tank would not flow into the second tank unless the water in the second tank was at a lower level than the water in the first tank. We might say that the electricity at the positive pole of a cell or battery is at a higher level than that of the negative pole. Therefore, when the two poles are connected by means of an electric wire, current flows from the positive pole to the negative pole. It must be remembered that a complete conducting path must be established between the two poles of the battery before current will flow. Such an arrangement is called an electric circuit. When the circuit is "open," no current will flow. When it is "closed," current will flow from the positive to the negative pole.

Only direct current has been considered so far. There is such a thing as alternating current. Such a current has a backward and forward motion in the wire; it flows first in one direction and then in the opposite direction. The number of times it oscillates or vibrates in a circuit is called its frequency. Alternating currents are not produced by electric cells. Generators or alternators are used to produce them.

Storage batteries are also used to produce electric currents. The storage battery should not be confused with the dry cell. We must feed current into a storage battery before the battery can be used. A simple storage cell (not a battery) produces a voltage of 2.2. Its amperage will depend entirely upon its size. The larger the cell the higher the amperage will be. A storage cell is illustrated at Figure 35.

The pressure of water in a pipe can be measured with a pressure gauge. Electrical pressure can also be measured with what we might call an "electric pressure gauge." This gauge is commonly referred to as a voltmeter. There is also such a thing as



A MAGNETIC FIELD

How the lines of force about the poles or ends of a horseshoe magnet array themselves. Magnetic fields have figured in many inventions.

A SIMPLE PRINCIPLE AWAITING PRACTICAL APPLICATION

Heated air becomes a partial conductor of electricity, and electric charges will be dissipated when hot bodies are present. Here a candle is being used to relieve an electroscope of its charge. It is simple scientific principles of this nature that often form the basis of important invention

an ammeter, which is used to measure the number of amperes flowing through a circuit.

Figure 36 shows what is known as a rheostat. This is one of the most important electrical devices. A rheostat is simply a coil of high-resistance wire. A slider moving contact is arranged on the coil so that when it is used in an electric circuit, the amount of wire in the circuit can be varied. In the sketch the slider is shown in a midway position. In such a case only half of the wire in the coil will be in the circuit. It can be understood, then, that a rheostat is simply a device which is used to control current or voltage. If we vary the amount of resistance in a circuit we will also vary the amount of current flowing or the pressure. A rheostat can be likened to a valve. If a water valve is wide open it will allow all the water to pass. If it is half closed it will allow only one half of the water in the pipe to pass.

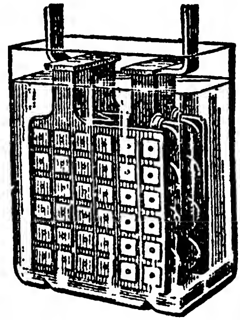


FIG. 35. A STORAGE CELL

The storage cell offers the only known method of keeping electric current over a period of time in a form in which it may readily be used. If some inventor could produce a storage battery that would hold several horsepower and that could at the same time be held in the palm of the hand, the transportation of the world would be revolutionized.

A wire carrying an electric current has about it what is known as a magnetic field. Every boy has played with the little toy horseshoe magnets sold in the toy shops. When such magnets are brought in contact with iron filings, the filings arrange themselves in definite lines, as though they were beaded on some invisible thread; something seems to be pulling them in a definite direction. There are the lines of force that extend about the poles of a permanent magnet.

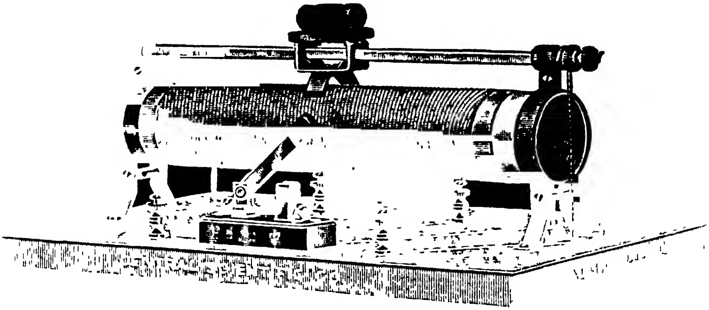


FIG. 36. THE RHEOSTAT

A common type of laboratory rheostat used in controlling electric voltage and amperage. These devices take on a number of different forms, although the basic principle is the same in all. Without such equipment it would not be possible to control direct-current machinery.

Magnetism is closely allied to electricity, although scientists do not thoroughly understand the connection between the two. A magnet field or magnetic lines of force extend about every wire carrying an electric current. In Figure 37 proof of this

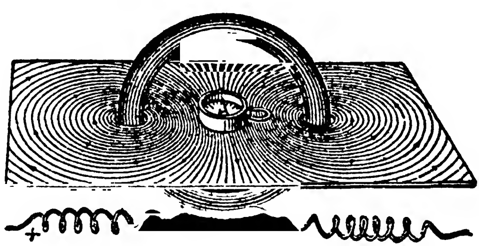


FIG. 37. A MAGNETIC FIELD

When a current of electricity passes through a wire, it sets up a magnetic field about this wire which can be discovered by means of a compass. To concentrate the magnetic field and make it available for useful applications, the wire is wound in the form of a coil. Such coils are called electromagnets.

will be seen. A coil of wire passes through a sheet of cardboard. The wire is carrying an electric current. If iron filings are placed on the cardboard, the tiny particles of iron will arrange themselves in definite lines. The magnetic field about the wire or coil will last only as long as the current lasts. Since a wire carrying a current has a magnetic field about it, this field can be concentrated by winding the wire into a coil. Every turn of the wire increases the strength of the magnetic field that will result when a current is passed through the wire.

In Figure 38 there is shown what is known as an electromagnet. This is a magnet the magnetic field of which is produced by electric current flowing through wire in coiled form. The two coils of wire are wound of an iron core. Iron is used to concentrate the magnetic field produced by the current in the wire. It has been found that iron conducts a magnetic field much more readily than any other substance. Therefore, it is used in the core of electromagnets. Steel is not used a great deal, simply because it becomes permanently magnetized. Iron, on the other hand, loses practically all of its magnetism when the current stops flowing. *A* is what is known as an armature. It is simply a piece of soft iron which is attracted by the electromagnets when current passes through them.

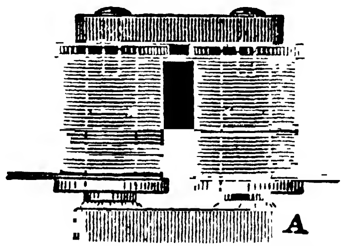



FIG. 38. A SIMPLE ELECTROMAGNET

One of the most serviceable devices in the world for the inventor: the simple electromagnet, which

of United States patents. The electromagnet affords a cheap and easy means of translating electrical energy directly into mechanical movements.

The strength of the magnetic field produced by these electro-

magnets depends upon several things. First and foremost it depends upon the number of turns of wire used in the magnets and the size of this wire. It also depends upon the amount of current passing through the wire. A heavy current passing through a great number of turns of wire would produce a powerful magnetic field.

Thousands of inventions have employed magnets. Indeed, the inventor has found a great many uses for this important electrical device. Telephones, door-bells, buzzers, locks, telegraph instruments, and relays are only a few of the instruments that depend upon simple electromagnets for their operation.

The electromagnet is capable of performing many mechanical operations, since it exerts a pulling power. This pulling power can be used to advantage in many different devices. For instance, an electromagnet can be used to operate the shutter of a camera; or it might be used as an automatic brake on a phonograph. One has only to keep one's eyes open in daily contact with things to see the little electromagnet performing in many different ways.

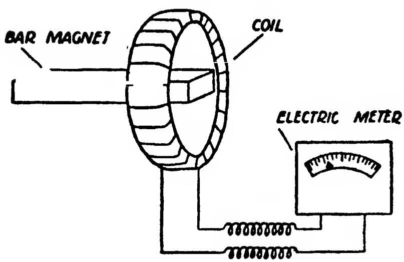



FIG. 39. THE PRINCIPLE OF THE DYNAMO

A magnet of the permanent type will generate a current in a coil of wire if it is moved about in the proximity of the coil. This principle was not only responsible for the development of the electric generator but for at least ten other very important inventions. Many other simple electrical laws and effects have been applied to the workaday world.

Reference is made to Figure 39. Here the reader will be further impressed with the connection that seems to exist between electricity and magnetism. A coil of wire is connected

to an electrical measuring instrument, which may be a sensitive voltmeter or ammeter. The bar in the center of the coil is a permanent steel magnet with a north and south pole. This permanent steel magnet produces a magnetic field. If the magnet is moved within the center of the coil in such a way that the coil passes through the magnetic lines of force, a current will be produced in the coil and its presence will be noticed by an indication on the measuring instrument. If the magnet is allowed to remain still, there will be no current. The magnet must be kept moving. This demonstrates the principle of the electric generator or dynamo. In the dynamo the moving coils are constantly cutting through the lines of force of the magnetic field produced by powerful magnets. Thus, as long as the armature, which is the moving element of the machine, is kept in motion, a current will be generated.

In Figure 40, we see two coils *A* and *B*. One coil is connected to *G*, which is a measuring instrument. The other coil is connected to a resistance *R* and battery *E*, and a key or switch *K*. Every time the switch *K* is closed, an electric current will travel from the battery through the resistance and through the coil. This current will set up a magnetic field and this field will spread out and generate a current in the coil *B*. Therefore, when the switch is closed, there will be an indication on the measuring instrument *G*. This shows how a current can be transferred from one coil to another or from one circuit to another. This process is called electromagnetic induction. Peculiarly enough, the current produced in *G* will only be momentary. The indicating instrument will give a little jerk at the time the key or switch *K* is depressed. To induce a constant current in coil *B*, the magnetic field must be kept moving. When coil *A* remains still, no current is produced at *B*. If an alternating current were passing through the

coil A, however, the magnetic field produced would be constantly vibrating in sympathy with the alternating current. Under such conditions a similar current would be produced

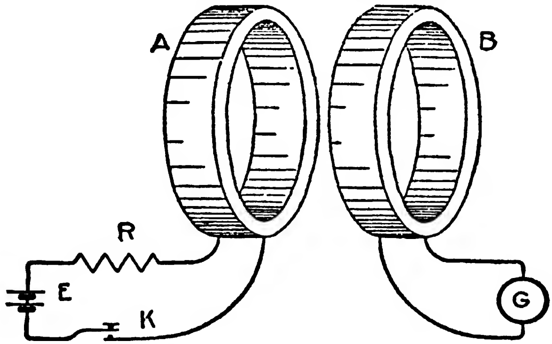



FIG. 40. ELECTROMAGNETIC INDUCTION

Although this experiment is nearly one hundred years old, it nevertheless brings about the wireless transmission of power on a small scale. If a current of electricity is set up in coil *A*, a small current will also be generated in Coil *B*, although the two coils are not in any way connected. Doubtless it will be from this principle that the wireless transmission of power will grow.

in the coil *B*. This is the principle used in electrical transformers.

So much for the subject of electricity. This treatment can be considered only as a bare introduction. The student is advised to carry on this study until he feels that he has a good sound working knowledge of electricity.

# CHAPTER IX

## WHAT AN INVENTOR SHOULD KNOW ABOUT SKETCHING AND DRAWING

THE inventor should be able to put his thoughts down on paper in the form of mechanical drawings. It is folly to go ahead with the construction of an experimental machine or device without first having sketched the idea out on paper. Oftentimes the impractical feature of a device will not present itself until it is roughly sketched out on the drawing board. On the other hand, of course, everything that looks well on the drawing board does not always work out in practice.

The inventor need not be an expert draughtsman. He need only acquaint himself with the barest fundamentals of practical mechanical drawing. He should simply know how to make sketches so that people may understand them in the event he wishes to have work done outside of his own shop. Aside from this, the inventor must know how to draw so that he can sketch out every one of his ideas before making actual experimental devices. Not even the smallest part should be constructed before it is thought out over the drawing board. Here it should be carefully laid down and properly proportioned. More ideas have been born over the drawing board than any other place in the world. A man sits down with his pipe, his T-square, his triangles, and other instruments, all of which help to stimulate his ideas.

Free-hand drawing should be resorted to only in preliminary sketches. The preliminary sketch should be rough and simply

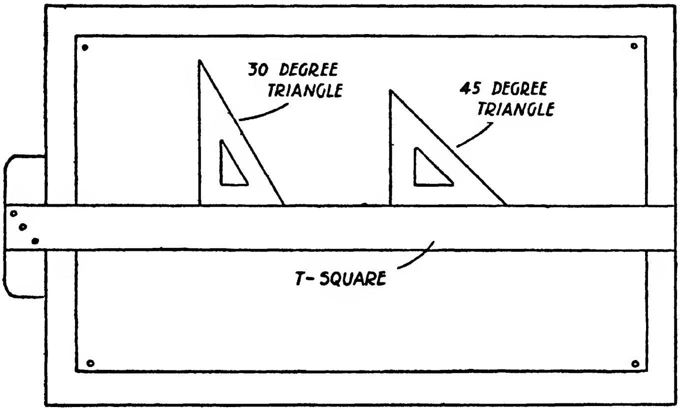



FIG. 41. HOW T-SQUARE AND TRIANGLES ARE USED IN COMBINATION WITH A DRAWING-BOARD

used to convey the idea. Then, after the preliminary sketch is completed, a really neat mechanical drawing should be made from it. One advantage that the mechanical drawing has over the sketch is that the workman will not be apt to confuse apparent dimensions as seen from the perspective with true measurements. All working drawings are made to scale and dimensions are proportionately and properly planned. Work-

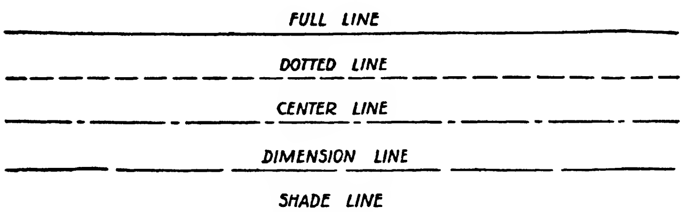



FIG. 42. THE FIVE PRINCIPLE LINES USED IN A MECHANICAL DRAWING AND THEIR MEANINGS

ing drawings should be made in such a way that even the rankest mechanic will be able to read them, otherwise there is apt to be a loss of time in the constructional work.

The following material is needed to work with:

A drawing board 16 in. x 21 in. should be purchased.

Keuffel & Esser or Eugene Dietzgen cream paper, size 12 in. x 16 in. or 15 in. should be used on the drawing board. Two-ply bristol paper is excellent also. For patent office drawings, three-ply bristol paper is required.

One dozen small thumb tacks are necessary to hold the paper to the drawing board.

Two grades of pencils are usually used. One should be 2H and one 4H.

A Faber eraser No. 211 and an ink eraser should be on hand. Art gum is also useful in cleaning up a drawing.

A triangular boxwood scale either of the Keuffel & Esser or Eugene Dietzgen type should be purchased.

The T-square used should be at least as long as the drawing board.

A collection of triangles is also needed. Celluloid triangles of 30, 45, and 60 degrees are best. Wooden triangles should not be used since they are inaccurate.

A piece of No. 000 sand paper is fastened to a block of wood. This is used to sharpen pencils.

A French curve should also be supplied. This is used to draw oddly shaped lines.

A set of instruments should be purchased, and the box should obtain the following items: one compass with lead and pen adjustment and lengthening bar; one large divider; one small divider (bow-spring); one ruling pen; one bow-spring compass (ink); one bow-spring compass (pencil); one box of leads; one protractor, one pen holder; one bottle Higgin's water-proof ink (black).

The paper should be tacked in the upper left-hand corner

of the drawing board so that the T-square may not slip when drawing the lowest lines on the plate. To get clean, sharp lines, pencils should be sharpened frequently, but under no circumstances should grooves be made on the drawing by heavy pressure on the pencil. A soft gum eraser is used to clean the drawing before inking, that a glossy finish to black lines may be retained. The worker uses ink erasers for pencil lines only in exceptional cases where the pencil has caused deep grooves in the paper. All additional lines should be erased before inking.

All dimensions should be stepped off from the scale or ruler, with dividers, and then pricked lightly in the required place on the drawing.

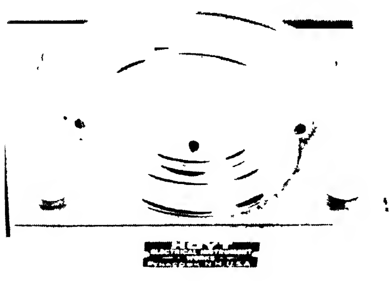
The triangles that are used to draw oblique and perpendicular lines should rest upon the upper edge of the T-square. Many and various combinations of angles may easily be made by combining both the 30–60 and 45–90. The oblique side of the triangle should always be to the right while in use, whether in inking or penciling.

The celluloid irregular or French curve is used in defining curves which are impossible to obtain with the compass. It is composed of many curves, but seldom has the right one, so that it is often necessary to shift it to many positions before required results may be obtained.

The compass legs are jointed so that the nibs of the pen may be at right angles to the surface of the paper while the circle is being drawn. The hand should describe the circle above the paper while in operation, and not remain stationary. The ruling-pen, on the other hand, should incline slightly in the direction of the line and should be held so that the nibs of the pen are not in contact with the edge of the T-square. To keep the instruments from corroding, they are polished with a

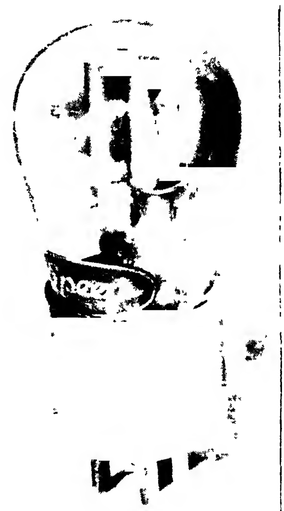
ELECTRICAL RESISTORS

Electrical resistors come in fixed and variable forms The form on the right permits of variation in the current or voltage by means of a sliding contact The form on the left is fixed Many electrical inventions call for a sound knowledge of the control of electric current



THE ELECTRIC METER

Electric meters are based on an electrical principle which was discovered long before there was any need for such measurements These devices are used to measure voltage, amperage, wattage, etc The more sensitive types are used to measure micro- and milli-amperes as well as micro- and millivolts It is also interesting to note that the same principle used in the voltmeter and ammeter is employed in talking pictures Indeed, talking pictures would be more or less impossible without this principle



THE RECTIFIER TUBE

Gaseous rectifier tubes used in converting alternating current into direct current are based on a principle that was discovered many years ago The inventor of the device simply reduced to practice an idea which had long been waiting for that touch of genius

small chamois skin and five cents' worth of chalk precipitate, or Spanish Whiting. Instruments must be kept clean. A thin piece of linen should be drawn between the nibs of the pen after each using, since the air congeals the ink quickly. The pen is filled by dropping the ink from the quill—which is in the stopper of the bottle—while being held in a vertical position. It should not be filled over one quarter of an inch, and lines are ruled from left to right and bottom upward, using the adjusting screw to get the right width.

The German protractor is a semi-circular instrument graduated into 180 degrees. This is used to obtain angles other than those obtained by the triangles.

If blue-prints are desired, the first original pencil drawing must be transferred to what is known as tracing cloth. Tracing cloth is transparent and it is placed directly over the original pencil drawing. The shiny side should be placed face down. When this is done, the draftsman will be able to see the pencil lines underneath. He can then trace over these with ink. First, all of the curved lines are reproduced on the tracing cloth. After this, all of the horizontal lines are inked in, and these are followed by the vertical lines. The letters and numbers are put in last.

We might divide the production of a drawing up into the following processes:

(1) Penciling on paper:
- (a) Choice of views.
- (b) Choice of scale and size of paper.
- (c) Location of views on sheet.
- (d) Drawing of principle lines in all views.
- (e) Drawing of secondary lines in all views.
- (f) Dimension lines, extension lines, arrows and dimensions.
- (g) Section lining, notes, title, border and trimming line.

(2) Tracing:
  (a) Stretch cloth over pencil work.
  (b) Inking in circles, arcs and irregular curves.
  (c) Inking in horizontal lines with T-square, vertical lines with triangle.
  (d) Inking in inclined lines and shade lines.
  (e) Dimension lines, extension lines and shade lines.
  (f) Arrows, figures, notes, titles, etc.

In laying off the dimensions of a drawing that is not full size, it is customary to use standard scales. These scales, although reduced in length, are always divided like a foot rule. Thus, a quarter-size scale is represented by three inches divided into twelve parts.

When large machinery is drawn, the scale system has to be used. The reader will understand that it would be impossible to make a full sized drawing of, say a locomotive. Every inch in a locomotive drawing represents several feet.

If the inventor decides to prepare his own patent applications, and feels capable of making the needed drawings, he will find it necessary to conform to certain very strict standards which have been set up by the Patent Office. The full specifications for drawings should be read (see Appendix), and it will also be advisable to follow the symbols shown herewith. These symbols have been published by the United States Patent Office, and possible correction or total rejection of a drawing may be avoided by adherence to them.

## CHAPTER X

### WHAT THE INVENTOR SHOULD KNOW ABOUT MANUFACTURING METHODS

TECHNOLOGICAL improvement in manufacturing methods has been so great during the past twenty-five years of our industrial development that it behooves the successful inventor to thoroughly understand these methods and to so design and construct his invention that it will be adaptable to modern production machinery. This is not, on the whole, a very small order, and yet it is one that must be filled at least to a moderate degree if the inventor is going to place his ideas in competition with the thousands of professional laboratory workers who are familiar with the technique of mass production.

Today as never before, competition has reached a stage where price is a primary consideration. Minimum costs with maximum efficiency is the iron-bound creed of every industrial establishment, and the inventor who cannot master at least an elementary knowledge of modern machine methods is placed at a distinct disadvantage. While he may arrive at his object and even produce an efficient device, he will have so neglected the purely economic rules of invention that his machine will have little or no commercial promise.

Manufacturing is divided into two parts, the production of the components and their assembly. It often happens that an invention will be soundly and cleverly designed but will fail to meet the needs of rapid assembly by more or less un-

skilled labor. As an instance, this was one of the early problems of our radio receiver manufacturers, and a large amount of the price paid for early sets was made necessary by the awkward and inefficient methods of assembly employed at the time. For years this has been the chief problem of the automobile industry, and while Ford's perfection of the progressive conveyor system did a great deal to reduce the labor and speed up operations, much of the cost of every automobile still goes to the prodigious amount of labor involved in putting the machines together. In the development of any machine, no matter how simple or how complicated, the inventor must always have this matter of assembly in his mind. If he does not, he may produce a device where the cost of the parts will be less than the labor necessary to place them in an operative condition.

While very few inventors will be able to master every detail of modern mass production, it will be necessary for the student of the art to at least understand certain key machines and methods. A trip through a modern factory would bring to view such important tools as milling machines, lathes, automatic screw machines (these are really modified lathes), multiple drills, broaching machines, boring mills, planers, punch presses, grinders, polishers, riveting machines, spot welders, seam welders, die-casting machines, presses for plastic materials, and power saws. While this list is by no means complete, it does contain all of the great elements with which an inventor should become more or less familiar. Books on machine-shop practice will be found in which the inventor will be able to gain an excellent knowledge of the limitations and operation of all primary production machinery.

If the student inventor is looking forward to the perfection of little household gadgets for sale in chain stores, he will do

well to devote much of his early preparation to a thorough understanding of a machine that has become the most important producing unit in the whole range of modern equipment. Reference is made to the ordinary punch press, which has become the basis of what is ordinarily referred to as the pressed metal industry. Here is a machine that has not only filled our chain and hardware stores with hundreds of cheap articles, but has made possible an entirely new technique of manufacture. By its use, sheet metal of all sorts may be pressed, formed, and drawn into practically any shape, and an unskilled mechanic may, by the simple matter of pressing his toe on a pedal, produce an article in less than a second's time that would have required a day's labor fifty years ago. By the use of such equipment, costs have been cut from dollars to pennies, and many of the devices and machines that we use today would be selling at exorbitant prices were it not for the homely, noisy, and seemingly cumbersome punch press.

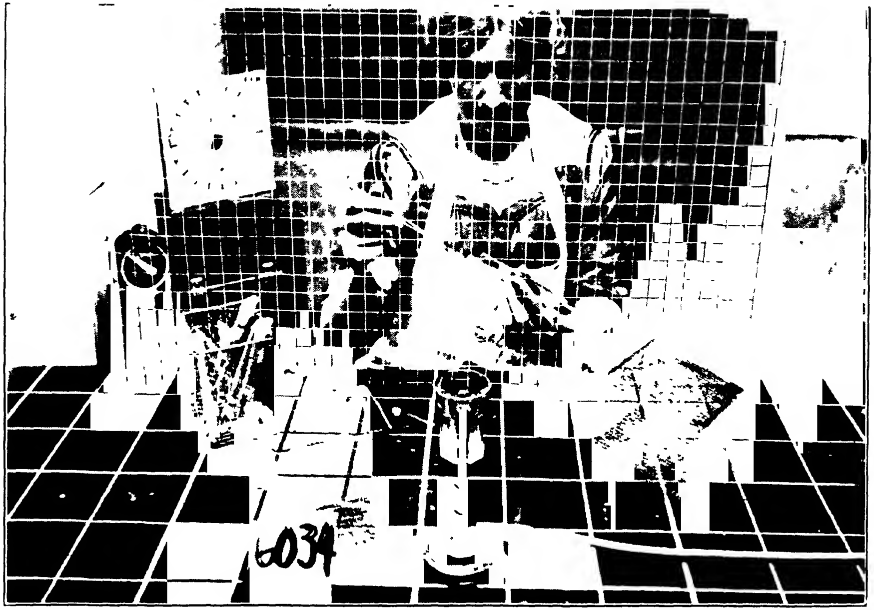
The wise student of invention will do well to study the parts of ordinary machinery as they come to his attention. The automobile should be one of the first objects of such study, for here we come to what is considered as the masterpiece of all modern production. Here everything but a fair degree of durability and more than a moderate degree of efficiency has been sacrificed to expediency and costs. In studying this object the observing student will be especially impressed with the part played by the punch press. Hundreds of parts have come from the oily mouth of this modern jack of all trades. And these parts are by no means limited in size. Indeed, some of the largest components of the modern car have been produced by this comparatively simple machine. In one mighty crash a whole mud guard is formed, cut and trimmed almost ready for finishing. When one thinks of the human labor that would

be necessary to form such an article by hand, one is appalled at the tremendous capacity for the elimination of human effort that this machine possesses.

In the old days, and they hark back but a few years, automobile manufacturers cast the crank case of every motor. Now they are stamped out almost as fast as pie tins. Not only do they cost less but they are stronger, they do not crack, and they are much lighter. To one who has followed a cast article from the pattern shop to the foundry and machine shop this development must be looked upon as one of the crowning achievements of mass production. Even the bodies of cars are punched out and formed by modified punch presses. The rims of wheels, the emergency brake handles, the radiator shells, and a hundred and one smaller articles have been made with this new magic.

A moment's thought will bring to mind the fact that the punch press replaces the pattern shop and the foundry, both the foundation of production a few years back. But why subject a part to this slow, tedious, and costly method of production when, with proper design, it may be made by the millions and with only a fraction of the cost? Then, too, it must be kept in mind that metallurgists have produced sheet metals with new and prodigious strength, and that by properly ribbing certain parts, pressed metal far surpasses cast metal. In the old days of automobile production, manufacturer used either castings or wrought-iron members to support the mud-guards of an automobile. Today these mud-guards are held by ribbed stampings. Unlike casting, they will not snap off, and they cost less than wrought iron members that would have to be forged.

The rapid development of pressed metal technique has brought forward the need of finding a suitable production




MOTION STUDY IS ESSENTIAL FOR LABOR-SAVING DEVICES

Inventors of labor-saving machinery will often find that they can very profitably employ the Gilbreth system of movement analysis. Gilbreth also tied small electric lights to the hands of operators who worked in the dark and permitted the lights to trace lines on a photographic plate. Thus was the motion of the hands recorded.

method of holding such articles together. Fortunately our electrical research workers have come forward with a beautiful solution to this problem. How, for instance, would the compressed components of an automobile body be held together were it not for electric welding? Rivets would be entirely out of the question, not only for reasons of general appearance, but because of the terrific cost of putting them in place and peening them over. Hence we come to another great asset of modern production that the inventor should understand; for electric welding has today become one of the major factors in rapid fabrication not only in the automobile but in many other industries as well. The rivet and the machine screw are being rapidly replaced, and while they will never entirely disappear, electric welding will do much to prevent their use except in cases where they cannot be replaced. Who, a few years ago, would have been daring enough to have predicted the substitution of welding for rivets in the construction of steel-framed buildings? Yet such a thing has come to pass, even though welding engineers claim that their art is still highly undeveloped! A few years ago, machine screws or rivets had to be slipped into drilled holes and tightened. Now the bare components are simply slipped under a spot welder and an actual union of the metals is established in the time that it would take merely to insert a rivet or a machine screw in a hole. It is obvious, then, that the inventor should, next to the punch press, have a sound elementary knowledge of welding systems, for here is the logical fabricating method of the punched component. Welding machines intended for different purposes take on a multitude of different forms, and a large number of books have been published outlining the phases of this important industrial development.

Mention has been made of the slow and tedious methods of

the pattern shop and the foundry, and while we can never become totally independent of these old bulwarks of production, engineers are at least ignoring them in the production of small machines. If an adding machine, as an example, is carefully examined, it will be found that precious few parts are cast. About the only thing that is cast in a typewriter is the frame. And then we come upon many examples of small machinery where the solid members are made by the new process of die casting, which amounts to the forcing of hot metal into hard metallic dies, the dies taking the place of the old-fashioned patterns and the sand molds. When die-casting machines first came forward as industrial units, it was possible to cast only in white metal. This white metal had a low melting point and was very fluid, but it had the disadvantage of a low tensile strength. A great deal of water has passed under the bridge since that time, and now our metallurgists have supplied us with die-casting metal possessed of a high degree of strength; and castings of this sort have found thousands of applications in a thousand different machines. So clean and perfect do they come from the smooth molds that they do not need to be filed or polished before they are enameled. Indeed, their appearance is sufficiently perfect to require no finishing when they are employed inside of the machines of which they form a part.

Still another method of avoiding the foundry has been found in the plastic industry. By the plastic industry we refer to the molding of plastic compounds like Bakelite and Beetleware. In such molding a dry powder is placed in a prepared mold of any shape and heated under pressure. There results a perfect casting possessing a fair degree of strength and a highly pleasing finish which requires no further work. At first these compounds were used almost exclusively in the electrical in-

dustry because of the high insulating value of the material; but today such plastic castings are being applied to a wide range of products, and especially in cases where eye appeal is a fundamental factor in lowering sales resistance. It may be said that no inventor's knowledge of manufacturing is complete unless he is acquainted with this highly important art.

In considering both die castings and plastic compounds it is well for the inventor to keep in mind the fact that either one of these methods is more costly than pressed metal; but even pressed metal has its limitations, which are rather severe in certain cases. If it is decided that either one of the above methods can be employed, it should be noted that bearings and other metallic inserts may be cast into such materials in the one operation. Oftentimes it is also possible to overcome the lack of strength by proper design and reinforcement at the proper points of strain. All in all, the inventor will find much to learn in this work, his object always being that of providing maximum efficiency and at the lowest possible cost.

It is only when inventors leave the minor inventions and ordinary gadgets that they are apt to run afoul of the methods of assembly now employed in the production of the more complicated machinery like cameras, washing machines, electric refrigerators, and the like. Inasmuch as a whole book could be devoted to this subject (and several excellent books have been published), it will be obvious that nothing more than the barest essentials may be touched upon here.

In the conveyor-belt method of progressive assembly a bare casting begins its journey and winds up an hour or so later as a completely finished machine ready for inspection and the testing room. Several hundred people might be employed in this assembly line, and each has his or her part to do and a certain limited time in which to do it. One man may put a

lever in place, another a gear, a third a pinion, and so on until the last operation. All told, several hundred parts may be coordinated and placed in an operative condition within a very short time. If a machine is awkwardly designed, it is obvious that this assembly is going to require more time and eat up more money. Parts must be kept to a minimum and they must be so designed that they can be handled easily and will slip into place with a minimum of trouble.

On the whole, this is a very large order, and the inventor in developing any kind of a machine must be "assembly conscious." Not for one moment should he permit himself to lose sight of his object, which is that of producing a device that will flow together smoothly and easily. After his machine is designed and assembled, he should take it apart and reassemble it piece by piece, studying each part as he goes along to make sure that he cannot improve upon it from a production angle.

Cost of production is the avenging god that strikes many an invention low. A device may be needed, it may do its work well, it may look good, it may have a market; but if its costs run to a point where merchandizing experts sense possible sales resistance of too potent a nature, the invention will die the hard and terrible death that comes to so many good ideas surrounded with bad economics.

If a composer were asked to write the music for a new show, he would want to know the nature of the show before he began setting his notes down. In a sense, the inventor is placed in much the same position. If there is a certain human need to be filled, there is a certain way in which it *must* be filled, and with so many production experts with sharpened pencils and merchandizing experts with sharpened wits, the inventor must produce an article that will fall into a certain and distinct

price category which will be commensurate with the service performed by the invention. For instance, if we had a cheap device whereby a man could cut his grass by pressing a button, the device would sell fast. If the machine cost a thousand dollars, however, it would not sell fast and would perhaps not sell at all, because the service performed would be entirely out of proportion to the cost. While this is a simple and perhaps crude example, it should be kept in mind that experts calculate very closely on such matters, and at times an added dollar that would have to be charged might turn out to be the deciding factor as to whether or not a certain invention was to be marketed.

There is always *one best way* of manufacturing a certain part. The cheaper the method used, assuming that the strength and efficiency of the part is decently preserved, the better. In the design and construction of parts the inventor is faced with many alternatives, and he must train himself to choose the most logical procedure. Thousands of inventors can succeed mechanically in producing a certain result, but few and far between are the inventors who can succeed economically.

After deciding upon design, there is still left the problem of materials. Shall a part be made of brass, bronze, iron, sheet metal, Bakelite, or aluminium? Shall it be cast, pressed, or molded? The material that a part is made of in many cases determines the manufacturing process that it will have to pass through, and this in turn helps to determine costs. Some metals work harder than others and some are stronger than others. Brass, for instance, machines far more easily than does aluminium. Tables are published that will give the tensile strength for all of the metals and alloys, but the inventor must make the final choice. That choice must be influenced by both factory methods and economical standards.

The smart inventor is ever a student of production. In the mechanical world things are moving very fast. Today's wonders are tomorrow's commonplaces and even tomorrow's brown derbies. Today a certain machine might be economically unsound, even though mechanically feasible, merely because a certain process involved in its construction was too costly. Tomorrow a new and cheap process might come along that would make the production of that machine a sound business proposition. An illustration might be given. Some years ago many thousands of dollars were spent trying to make an all-aluminium automobile engine. Aluminium was too soft to withstand the abuse inside the cylinders, to say nothing of the wear produced by the ever-passing pistons. Only recently there has appeared a commercial development that may overcome this problem of the all-aluminium motor. Curiously enough, it has bobbed up in a most unexpected quarter. Surely the average inventor would not expect to find this problem solved in an electroplating plant, but that is just where it has been solved. If it were said that a method had finally been found to deposit chromium on aluminium, many inventors would still fail to see the point. Not so with the man who knew his manufacturing materials and the physical constants of these materials. He would know that previously all efforts to make chromium stick to aluminium had failed and that chromium is one of the hardest, wear-resisting metals known to science. This man would immediately see the possibility of plating the cylinder walls of an aluminium motor block with chromium. Just such a thing has happened and, according to last reports, this motor had been run for twenty-five thousand miles without showing even microscopic wear.

There are dozens of trade and commercial magazines to be found in the local library that will keep inventors informed

concerning new methods of production. To keep abreast of these things is part of an inventor's stock in trade. To lose sight of them is to lose a grip on things that may eventually cause years of hard and fruitless effort in producing something that the world may want but cannot afford to pay for.

# CHAPTER XI

## HOW INVENTIONS ARE DEVELOPED

MERE ideas are worthless until they have been proven practical by the methods herein outlined. It is one thing to be struck with an idea and quite another thing to reduce that idea to a practical form commercially acceptable and capable of efficiently functioning in the manner intended. Far too many "paper ideas" filter through the Patent Office each year and far too many inventors fail to realize financial reward for their inventions because their work has been only half completed. Rare indeed is the idea that can jump from paper to the markets of the country without having had its baptism of fire, its growing pains, its disappointments, and its painful, slow development.

While it is not possible to actually reduce the method of inventing to an exact formula that will take into consideration the idiosyncracies of all those who would invent, it is possible to set down the method used by well-trained men who have won fame and fortune in their chosen field. The student is merely asked to study these methods and to hold himself as far as possible within the most practical limits. There are no "secrets" to be revealed, and any cautious man may apply the methods with every assurance of success if he is patient and persevering.

The new-born idea should first be thought of from a purely legal standpoint, regardless of its degree of perfection either

real or imagined. It is the *first* thought of the inventor to stake out his claim, so to speak; he must legally establish his right to the idea by executing what is known as the "evidence of conception." Full directions for this important work are given in Chapter III, and they should be carried out to the letter.

This done, the inventor must decide whether or not his idea is new. But surely nobody could have *this* idea? It is subtle, it is clever, and it was a real inspiration. Such thoughts are dangerous, and not one man in a thousand will keep in mind the fact that we have 120,000,000 thinking Americans who live, on the whole, in a very mechanical environment. Nor will would-be inventors stop at the fact that our Patent Office has in its files over 2,000,000 patented ideas. Thousands of men file patent applications each year only to find, perhaps after much hard work and expenditure, that their ideas are old and tried. The fact that these men have never heard of or seen such ideas in use means little.

To reduce this hazard, the worker must have the Patent Office searched by a competent person, usually a patent attorney. To do this he reveals his idea to the attorney and the attorney in turn systematically combs the file of the Office, turning over all of the references (copies of patents dealing with similar articles) to the inventor. Rare is the search that does not bring to light at least one copy of a patent dealing with an invention along the same line. Oftentimes a dozen or more patents will be brought to light, but even this is not necessarily a cause for despair. It is now the inventor's task to examine each one of these patents with the thought of determining whether or not he will proceed with the development of his own idea. It is no time to jump at conclusions. Perhaps the inventor's idea is more practical. Perhaps he has

managed to overcome the one real difficulty that stood between old ideas and practical application. Then, too, there is always the prospect that this study of the art will result in an altogether new conception that offers one grand and final solution to the problem.

If the idea is found old, time and money have been saved, to say nothing of tragic disappointment. After all, it is one of the inventor's problems to eliminate waste effort, and to prevent it should not be fatal in any sense of the word. Should the inventor find that his idea represents an improvement over existing patents, he will also do well to keep in mind the fact that improvement patents are limited in scope and that, in the case of unexpired rights, he is placed more or less at the mercy of the original inventor. Of course, if the original patent has expired, this is not the case, and he may find it advisable to proceed in the perfection of his own idea, provided his idea is the one thing necessary to make the first idea practical and usable.

That an idea has been patented is by no means proof that that idea is good and usable. Our Patent Office does not insist upon this point, and it is well for the student to be constantly aware of this when he is examining what is known as the "prior art" in connection with any proposed invention.

So much for the more or less legal side of the matter. The reader will find more lengthy references to the subject as he progresses with his study of the remainder of this volume. From this point on it will be assumed that he has convinced himself that his idea is worth while and that it has a good chance of meeting with financial success.

When an inexperienced investor makes a commitment in the stock market, his imagination often outstrips his judgment; and so it is with the inventor flushed with a new idea.

That idea must be worth a million dollars. The very person who should be most cautious and critical of a new thought is the one who is most apt to jump at conclusions. Hence, after the inventor has decided that his idea is worth following, he should turn to its practical side and attempt to prove that the idea will *not* work. He should criticize it in a most unmerciful manner, tearing it to pieces bit by bit until he is positive that nothing more can be done by way of proving, for the moment at least, that the thing will not work with its original design. If any new invention can survive the conscientious application of this principle, it has reached a point where the sleeves can be rolled up and the work of the actual material development begun.

The human mind thinks in pictures and objects more than it thinks in words. It is easy to understand, then, that most inventors do a great deal of their thinking on paper. The mind alone is not analytical enough, and it is only when an actual idea lies spread out before one in the form of a drawing that the mind really warms to the task of grasping its essentials, and more especially the coördination of these essentials. Time and time again an inventor will have a new idea and draw sketches of it only to find that the proposed device is inoperable. The unaided mind cannot measure distances accurately, it is easily confused by complication, and mechanical coördination of a strictly accurate order is beyond its limitations.

From this it will be evident that a pencil and a pad of paper are the inventor's most valuable assets. It takes but a minute to prove that a part will not work on paper, but it takes perhaps hours to prove that it will not work in material form. A famous inventor once told the writer that he drew and discarded over six hundred sketches of a single part before he

came upon the solution of the problem. When an idea has passed through this form of intense analysis, it is quite apt to meet the needs of the situation, and one can easily see what time would have been lost if this man had stopped to make each one of the parts that he sketched.

Sketching of this sort is the greatest possible stimulation for the imagination. The mind actually comes to grips with the idea; it has something tangible on which to fasten itself, and it is utterly amazing to see how development will progress when this simple method is used. This is especially so if each drawing is carefully studied, and there is always the possibility that a sudden inspiration will burst forth that will offer the happy and immediate solution. While it is true that inspirations of this sort cannot be predicted, the circumstances under which they are most apt to appear can be provided by any man regardless of his training.

Sketching of this sort also helps the inventor to isolate his main problem, which may be surrounded with a hundred minor problems. Here the process of eliminating parts must not be lost sight of; every element in a new invention must fight its own way in and every effort must be made to throw it out if possible. The balance between parts and efficiency must be brought about by "cut and try," and in this work the inventor will be greatly aided by referring to some standard works on mechanical movements. Some excellent treatments showing all of the well-known mechanical movements have been published, and few indeed are the functions that cannot be performed by the application of known principles. The fact that the principles are known does not necessarily interfere with the validity of the invention so long as the result is new and novel. After all, we have but few mechanical elements and few basic applications. The Geneva movement in the moving picture pro-

jector was one of the first really new mechanical movements that had been developed in many years.

There are certain questions that the inventor must keep in mind as he progresses with his sketching. Among these is the question of strength. What metal, what material is to be specified to do a certain job, to overcome a certain strain? Does the inventor know that certain forms are weak and others strong? Does he recognize the necessity of keeping the weight of the machine down to a minimum? Added weight means added material, and added material means greater costs in manufacture and in shipping which, in these days of high transportation charges, might prevent an invention from being successful in the West even though it were successful in the East. Data on this and allied subjects can be found in many books devoted to mechanical engineering and machine design where it will be found, for instance, that steel tubes are stronger than steel rods, and that I-beams and angle-iron efficiently take the place of solid members three times their weight. If the designers of typewriters did not rib the key levers, typewriters would not be as small or have the weight that they now have.

In speaking of weight and strength one cannot help but think of the modern use of pressed metal and the way in which it is being used to replace the heavier and more expensive castings. Here is a subject that inventors must investigate before they can feel thoroughly qualified to design machinery. They do not need to master the subject, but they can become aware of the many opportunities that such material offers for short cuts and the elimination of weight and the reduction of costs. Here again the local public library will yield a number of important and interesting reference books devoted to the subject.

Eliminating or reducing of wear is another matter to which the ambitious student must devote some of his attention. Certain metals wear very poorly, and therefore the contacting elements in a machine that move over each other must be properly treated. Steel members can be case-hardened and alloyed copper can be had that will not only resist wear but survive flexing or bending to a marked degree. To assume without question that an aluminium member will replace a steel or brass one without consulting physical tables is not a wise thing to do, especially when such tables are readily available.

In this matter of wear, the inventor should not overlook the possibility of reducing his wearing parts to an utter minimum. By this is meant parts that are moving over each other either by sliding or rolling. Rolling, sliding, and other moving parts require lubrication, and lubrication necessitates oil cups, grease cups, and oil holes, to say nothing of the necessity of constant attention to keep these members filled. Ultimate perfection comes only with simplicity, and if there is a watchword of successful inventing, that is it.

The elimination or reduction of wear also takes on another meaning, for with it there is closely allied the matter of power consumption in the case of larger and heavier machinery. Power costs money, and power is consumed when friction is overcome. A few men can move a locomotive equipped with roller bearings, whereas a few horses cannot move locomotives of the old type. It is well that the inventor know something about bearings.

Where machines are being designed, or some mechanical toys, for that matter, the question of power transmission within the machine itself is a matter of grave importance. There are a number of ways in which power can be transmitted. In locomotives of the steam type, the power from the

steam cylinder is transmitted to the driver wheels through the medium of connecting rods. Gears and belts are also used for power transmission. Belts slip and gears do not. Hence when perfect coördination between certain moving parts is to be brought about, belts are automatically ruled out.

It is well to treat every part of an invention as an independent invention, and it is indeed not uncommon that inventors patent separate parts of their inventions that can find widespread use. No part of any machine or apparatus is too small or too insignificant or obvious to receive very mature consideration from the inventor.

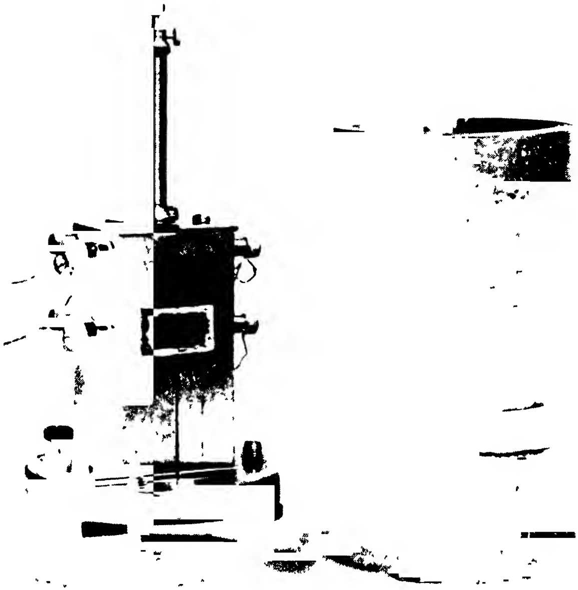
Even though all of these rules have been followed with due care, the idea should not yet have reached the stage where actual trial and construction are resorted to. Such form of development may go on for weeks and even months before the inventor feels that it is advisable to put his creation into material form. There is really no hurry. Every man has two years in which to perfect his invention, and perfection should be carried to the *nth* degree. Inventions must be lived with and thought of for long periods if they are to have that final polish which rapidly promotes them into the world of everyday, useful things. But precious few ideas are so simple that they can be perfected in the course of a few days. It is only drawing, thinking, scheming, and concentration of the highest order that result in final triumph. If the reader is looking for a short road to wealth that involves inspiration alone, he is advised to turn his talents to other fields. This does not mean that he will not have such inspirations, but the chances are against it. It is true that fortune can be won very quickly in the field of invention, but it is not always a painless process.

After having exhausted his mind of every possible avenue

of approach in bringing his idea to a satisfactory point of perfection, then and then only does the inventor think of putting the invention into a workable form. By this time he is sure of the dimensions and the design of every part in so far as it is possible to arrive at such figures from drawings only. Guesswork as far as possible should be eliminated. Materials should have been decided upon and the stage all set for aggressive action.

Most inventions are developed by "cut and try." When a part has definitely proven that it will not function as the designer intended, it is immediately removed and replaced with a design that bears more promise of successful operation. As the inventor digs down in his problem, he will find this to be very true. Not only this, but he will find that certain parts may be taken out entirely. He now has something solid and substantial in his hands to work with, and more positive opinions can be formed more rapidly. Either a part is right or it is not right. Either it stays or is eliminated without ceremony. Nothing is sacred here, and the inventor may be called upon to cast off the very part of the invention that flattered his ingenuity most.

If the inventor is not confronted with new ideas and better ways of doing things in this physical growth of his invention, something will be wrong either with the invention or the man responsible for it. It is this actual rearing of the thing that stimulates the imagination most. Here faults and shortcomings stick out like sore thumbs. Operation alone is not enough. Perfect operation with perfect simplicity is the thing to be aimed at, and simplicity is the thing that is of great interest to the Patent Office. Simplicity, our Patent Office examiners hold, is the most direct route to perfect protection and the greatest testament of ingenuity.



THE FOUNDATION OF TALKING PICTURES

The Thomson galvanometer is based on a well-known electrical principle which has made possible talking pictures and many other inventions in use today. Delicate and sometimes unnoticed effects often become the basis of great inventions.

The true inventor is never dogmatic. He is never so sure of himself that he is not open to suggestions and to new ideas. If one idea is proven unsuited to a certain need, the search for a new one is instituted immediately. The thing is thrown out of mind completely and a wholly fresh viewpoint is taken. Precedent should mean little to an inventor: independence of mind is what makes him an inventor. Perhaps a new mechanical movement will do the trick, or perhaps an electrically operated mechanism will bring about the desired result. It is well to know, after all, that motion of a nicely controlled nature can be introduced by the use of electric solenoids and magnets, and that an increasingly large number of our machines are taking advantage of this fact. The new and better way to skin the cat is ever the quest of the man with a new idea to perfect.

The inventor isolates his main problem and then successively isolates his minor problems one by one. In a sense, he is the commander in a well-fought battle. Slowly but surely he captures one position after another until his main objective stands before him. There can be no compromise with time or trouble in arriving at results, and results must be analyzed dispassionately. The lesson of the inventor who brought a new camera to George Eastman should be well learned. Eastman tore the thing apart before the man's eyes and told him that the public should not be able to tear things apart so easily. The invention was only half complete.

If an attempt were made to reduce the work of perfecting an idea to an actual formula, the formula would take on a form something like the following:

1. Is the idea practical?
2. Is the idea new?
3. Will a sufficiently large number of people use the invention?

4. The effort to bring to light other work that has been done.
5. The decision as to whether to continue or not in the light of the references found by this search.
6. Can the new invention be manufactured at a price that will be commensurate with the work it will do?
7. Placing the idea on paper.
8. Providing preliminary legal protection.
9. Knowing the elements of design.
10. A knowledge of the best materials to use.
11. Reducing the idea to its simplest possible form.
12. Elimination of wear.
13. Eliminating unnecessary expense in manufacture.
14. Keeping an open mind.
15. Reduction of weight.
16. Substitution of cheaper materials without cutting down durability and efficiency.
17. Looking upon each part as a separate invention.
18. Reduction of friction and thereby power consumption.
19. Tireless experimentation.
20. Greatest possible speed of operation.
21. Elimination of all unnecessary human hazard in the operation of the machine or device.

Like the pad of paper, the notebook is the silent helper of the inventor. It should always be at his elbow or in his pocket. Edison's notebooks would have filled volumes. Each flash, each tiny thought, no matter how insignificant at the moment, was jotted down. The germ of a new idea is not always obvious. Perhaps a little thought and a few experiments will make it grow into something big and useful. It is, furthermore, bad to trust to the memory of an active mind. Things are forgotten, important things that may spell the difference between success and failure. And things are after all only relatively small. Some of the greatest inventions of our time have resulted from the observation of things that might have been too small for some inventors to consider.

Nearly fifty years ago a man then unhonored and unsung was bending over a crucible in a dark and dingy laboratory. He had struck an electric arc and the sharp, blue rays lit his tense, expectant face. Cautiously he removed the contents of his little improvised electric furnace, pawing over the meaningless mass of material as the half-starved miner feverishly examines his pay dirt. And to the ordinary eye there would have been little more than dirt in that crucible. Not one man in a thousand would have been able to find the millions of dollars that lay buried in this seemingly hopeless and uninviting mess. This man was observant, he was patient, and he knew that the greatest gifts of the gods often hang on trifles.

His keen eye caught the glimmer of a tiny speck that appeared hard and resistant. He carefully removed it and, as a simple and convenient means of testing its hardness, he drew it across a pane of window glass. It cut the glass. It cut diamonds; it cut anything. Thus came to light a simple compound bearing the chemical formula of SiC (silicon carbide, or carborundum) which was destined to bring about an industrial revolution of the first order. Edward Goodrich Acheson, who made this discovery, lived to see it prosper and to spend the vast sums that it earned. Yet he had made no effort to create it. Indeed, he was at the time aiming to do something entirely different.

A man who is incapable of painstaking observation and attention to the smallest details will show little aptitude for invention. If he does not have it, he must develop it. An inventor is something like an explorer. He never knows what will be revealed when he reaches the top of the beckoning hill or turns the bend in the river. Was it not Columbus who tried to discover a shorter route to India?

Men engaged in research work are always mindful of un-

expected results. Either this or they would not be research men. The experts at work in the great laboratories of the General Electric Company have time and time again stumbled upon commercially important discoveries that were far removed from the problems that brought them to the fore. Observation is part of their ritual, it is part of the thing that they live by and live for, and they know full well that research can never be separated from the element of chance.

Observation does not need to be cultivated only in connection with formal research. It should be the principal asset of every inventor, whether he be engaged in the perfection of a new screw-driver or a process to produce hexadecyl alcohol. After all, keen observation and the attention to details are closely allied to analysis, and nothing is possible without analysis. It is not to be assumed that observation is to be cultivated solely for the purpose of discovering some chance effect or result that will bring a million dollars. In certain aspects of research work these possibilities are undoubtedly present, but they are rarely present in finding solutions to ordinary mechanical problems. That does not prove, however, that observation is not important in solving problems. It is and always will be. It is part of finding the way to new things.

When it is proposed to perfect a device already in use, it is the inventor's work to make an extended study of the deficiencies of the article to be improved. If the result of this work is to be anything more than a haphazard solution, hours of observation must be spent. As an example, it will be assumed that an inventor is faced with the prospects of making a new sort of an egg beater, a device with which every reader will be familiar. But why try to improve an egg beater? It is already a simple device, it is cheap, and it does its work

well. Perhaps that is the way some minds would jump to conclusions, but the true inventor likes to think and to think for himself. That an egg beater meets with all of these specifications may, after all, be merely the consensus of opinion.

What is there left for an egg beater to do that it cannot now do? Can the construction be so changed as to cheapen the article or bring about more efficient operation? The inventor sits and contemplates the device as it lies before him. Is the basic principle of the thing right? Can a new mechanical movement be used? Can better blades be devised? Can the article be made lighter? How about speed? Can the blades be speeded up? But wait, how about the consistency of the material being beaten? Is that not a factor that will sometimes determine speed? Ah, clues are beginning to develop. Speed, *speed,* SPEED. What about variable speed so that the housewife could use a higher speed with egg whites and other more liquid materials and a lower speed with thick cake batters? From a purely mechanical viewpoint this would make cake batter much easier to mix and beat. What about a three-geared egg beater built on the principle of the automobile gear shift? But this would perhaps be too expensive. But what about a gearless method of producing variation of speed? Is that not cheaper? But it is not as efficient. Why is it not as efficient? Perhaps that can be remedied, perhaps a new way can be found. But will the new way be simple, and will the housewife be able to use it without trouble? Can she keep it clean? Will it wear out too soon? Once more, can she keep it clean? There is a thought. Women today complain about the difficulty of washing egg beaters after they have been used to mix sticky icing. Here is a point worth thinking about. Perhaps the idea of a triple or variable speed egg beater is not nearly so important to the housekeeper as an egg beater that can be easily washed. Which will a

woman appreciate most in her perfectly womanly manner of measuring the merits of the various articles offered to her? Would she really understand the advantages of a three speed beater? It is a safe bet that she would not. She could not get her mind around the mechanics of the thing; they would mean little or nothing to her. Does she really object to using a little more energy on cake batters than she has to use to beat the whites of eggs? The chances are that she never gave the matter a thought. On the other hand, she could see with her own eyes that a beater built along new and proper lines would lend itself better to washing. That, then, shall be the object of the inventive effort. But is there really nothing else about an egg beater that can be improved?

Getting down to basic facts, what does an egg beater do? "Why, it just beats," the thoughtless fellow will say. If it just beats, it would be an almost useless article. Then it mixes. Yes, it does mix, but that again does not completely describe its mission in the kitchen. If mother put an icing on a cake that was just mixed, or asked a person to drink an egg-nog that was merely swirled around, neither the cake nor the egg-nog would be palatable. Something more happens. Air is mixed with the material being beaten, and the greater the beating and the faster, the more air will be present at the end. That is what helps to make cakes light and egg-nogs frothy and delicious. Even mineral oil can be beaten up into a pluff with a high-speed beater. In the last analysis, then, an egg beater is used (1) to mix ingredients and (2) to aërate them. If a revolutionary method is to be found to replace the egg beater, these basic facts must be sought out.

Now does the finding of the basic facts lead to a solution? Can compressed air be used in any manner? But that will only put the air in, it will not mix the material. A little further

thought will show that it will do neither. However, it is possible to use the air in a special way to bring this result about. Fine, but what about the matter of generating compressed air? That is simple. It can be done with a small electric motor. Time for a little caution here. The object of all of this thought has been that of producing a better and cheaper egg beater. Electric motors cost money. Perhaps a new compressed-air principle can be devised that will take the place of the ordinary electric beaters now on the market. But if this line of thought is to be followed, there will have to be a parting of the ways. The original thought of the cheap egg beater will have to be abandoned and energy will have to be concentrated on the new idea. This is the way of inventors, however, so long as the new idea has more promise than the old one. One never knows what the end of a trail will reveal or where it will lead. It all amounts to an exciting chase.

The above is a crude outline of the way inventors think and reason as they exercise their powers of observation. In short, it is the method used to invent, and no other system can ever replace it. Perhaps system is the wrong word. Is it not just plain "hoss-sense" thinking?

# CHAPTER XII

## KEEPING RECORDS OF RESEARCH AND INVENTION

NOT many inventors would accord this chapter the importance that it deserves. This is indeed a sad commentary on the preparation that the average inventor gives himself for his work, but it is true. The keeping of legally acceptable records is part and parcel of successful invention, and many an inventor has reached court bare and clean of any acceptable evidence in his own behalf. By the same token he has left court shorn of that which was rightfully his and we find him sad and disillusioned, muttering his hatred for those who have cheated him out of his just reward. This is tragedy in its highest form, and let no one mistake the fact. The writer has had enough contact with struggling improvers of civilization to know whereof he speaks.

Many of these heartaches, these fruitless struggles, and these stings of bitter defeat could be very easily avoided, and they are avoided by inventors who accept their work as business and who employ the methods of business. The wise inventor builds up his protection step by step as he proceeds with his work, and by the time he reaches the Patent Office he is armed with proof that any adverse testimony will have a difficult time breaking down. The establishment of this proof requires but little of his time and practically nothing in the way of expense. Consequently there is little excuse to proceed in the development of any new idea without it.

The first thing to be discussed is the "evidence of conception," or the "date of conception," as it is perhaps more often called. Some mention is made of this elsewhere in this volume, but here the exact method of procedure will be treated in detail. The student inventor who thinks that he knows all there is to be known about this subject will be wise to persist in his reading, for the writer has found precious few workers in this field who have a clear, clean-cut understanding of this highly important phase of the art.

It has been said that the United States Government recognizes the man who has an idea *first* and who can prove that he had it first in the event of a contest for ownership. And let it be said that there is no favoritism shown in the matter, whether or not it is the poor inventor versus the billion-dollar corporation. Billion-dollar corporations are beaten in court just as often as the poor inventor. If the poor man has his evidence tucked away, his defense is perfect.

Instantly a new idea takes form, the inventor should not rush to his workshop. He should rush to his desk. He makes as complete a drawing as possible and writes as complete a description as possible. It is the object of this drawing and description to communicate his idea to other people, harsh as this advice may seem to the benighted individual who works in dark cellars and with the utmost secrecy. Inasmuch as the description and the drawing will be viewed by people who may not understand the field to which the invention applies, it is important that it be as clear as possible. Most inventors prefer to work these details out in pen and ink on one piece of paper to avoid any possible question in court; but the important thing is to get them down, pen or pencil.

The next piece of advice will be a sad blow to the lone wolf, to the inventor who thinks that everybody is trying to

steal his ideas. After the evidence of conception is prepared, it is advisable for the inventor to produce two witnesses who go with him to the office of a notary public who fixes his signature and seal to the document in the presence of these witnesses, who also sign. More than this, the inventor should make sure that these witnesses understand every detail of the invention before the paper is signed. If this is not done, the whole object of having executed the instrument will have disappeared. These witnesses are included for future possible use. Should the inventor find that his application in the Patent Office was contested by another applicant and interference declared, he would have available two very important people who would mount the stand and tell what they knew about the idea: when it was conceived, etc. They would have to know the idea from A to Z to be of greatest help, but their testimony would be far cheaper than the services of a good patent lawyer. Stupid indeed would be the "smart" inventor who kept some key detail from his witnesses with the thought that he would in this way give himself secret protection. Such a thing might cost him the right to his idea. And furthermore, such action would be wholly unnecessary for the simple reason that, even though these witnesses wanted to steal the idea, they would be faced with the necessity of establishing perjury not only on their own part but on the part of a notary public who is entrusted with public trust. This would indeed be a most dangerous procedure, with a jail sentence as the price of failure.

Perhaps the mention of a famous case will serve to impress the doubtful reader with the grave importance of such a form of protection. A man by the name of Drawbaugh reached the Patent Office about one hour after Bell had filed his application covering the telephone instrument. Drawbaugh had

also invented the telephone, and the two inventors were required to prove their positions. A long-drawn-out court procedure wound up in the United States Supreme Court, which heard over three hundred witnesses in favor of Drawbaugh. Curiously enough, not one of these witnesses could provide an intelligible description of Drawbaugh's invention for the simple reason that he had not, in his desire for secrecy, explained it to them. He lost the case to Bell and millions in reward.

Inasmuch as evidence of conception has no foundation either in rule or in statute, its purpose is that of establishing valuable witnesses. Merely to prepare such a document and file it away means very little. What the inventor needs is the assistance of men or women who know all about his idea: how it works and when he first thought of it. Indeed, the number of witnesses does not need to begin and end with those who signed the evidence of conception. Others can and should be included at a later time—the next day, for instance. If Drawbaugh had had just one good witness, this witness would have been better than the three hundred poor ones.

To sum up, it might be said that the evidence of conception amounts to a safe and legal way of producing witnesses. Any other idea of it will be in error. Furthermore, one evidence of conception is not usually enough, for the simple reason that the first blush of the inventor's idea is usually crude and imperfect. Hence, the inventor should make it a point to execute more of these documents as his invention is improved. This gives a splendid background of diligence in court; it shows that the inventor was on his toes in reducing his idea to practice, thereby conforming with the spirit of the patent law.

The careful worker takes advantage of every bit of possible evidence. When he buys materials for his idea, he obtains duly

receipted buying slips or bills and files them away after making sure that they are dated. If he has a search made in the Patent Office, he also files the references away, together with the letters from the attorney who did the searching. These are little things at the moment they are done, but they can turn out to be very big things if the inventor ever reaches court and is called upon to show proof and establish his right to ownership.

Coming back to the matter of the evidence of conception, it might be advisable to mention a refinement that can be added with very little cost and trouble. If this evidence is made on a large and heavy piece of drawing paper with the description and the drawing all on one side, the paper can be folded up, glued together, and sent through the registry department of the local post office. Naturally the inventor sends the evidence to himself, and the object in so doing is to obtain the date on the drawing and to know that this is an official date which has some standing in court. Such registration costs but a few pennies and is very much worth while.

These things may appear trivial to the impatient person, but our court records are filled with the sad defeats of the fellows who took a chance.

## CHAPTER XIII

### THE PRACTICAL APPLICATION OF SCIENTIFIC PRINCIPLES

MANY years ago Lord Kelvin discovered that a gas stored under pressure and allowed to escape through a small orifice cooled itself. If his commercial sense had been as keen as his scientific sense, he would have then perfected the electric refrigerator. However, he preferred to account for the effect on the basis of the second law of thermodynamics, and American housewives had to wait for more practical men to supply them with the luxury of an electric ice-box. This is but one instance where a more or less minor scientific discovery has been turned into a major commercial development. Men who surround themselves with interferometers, polariscopes, microscopes, and micro-ammeters and who dream in the realm of differential equations often discover those seemingly "little effects" that are later seized by more practical minds and turned to meet the needs of the world.

Hertz, inspired by Maxwell, pulled radio waves from nature's archives and played with them so intensely that he entirely overlooked the fact that they might have some commercial value. He made them do laboratory somersaults, bent them and focused them without being even mildly conscious of the terrific import of his discovery. Marconi took the toy away from Hertz and made it do more practical tricks, tricks that made money and set the world agog.

A whole book could be prepared with such incidents; cases

where practical-minded men have taken up the loose ends of scientific discovery and woven them into the fabric of the commercial, workaday world. It has been done much in the past and it will be done even more in the future. Hence this chapter, which is to deal with the more practical aspects of exploiting those little siftings and findings that so often leak out into the realm of everyday things through publication in the proceedings of the various scientific societies.

There is oftentimes a very short distance between pure and applied science and the inventor, as a part of his training, should not neglect the matter of studying ordinary high-school physics. Our physics books still contain the outline of many simple scientific principles that almost cry aloud for practical application. Indeed, many of our most wonderful modern inventions have come from this source and have been inspired by work that was done many years ago by the savants of Europe and America. It was back in the '80's that Hallwachs discovered the fact that negatively charged bodies were relieved of their charges by mere exposure to light. Today this principle, taking the well-known form of the photo-electric cell, is controlling the elevators in skyscrapers, opening the doors to the train shed at the Pennsylvania Station in New York City, sorting the cigars in tobacco factories, controlling the motors on the run-out tables of sheet-steel mills and doing at least two hundred other important industrial chores. During the past ten years hundreds of patents concerning photo-electric control have passed through our Patent Office; yet this basic discovery is fifty years old and was brought to light by a man practically unhonored and unsung.

Many years ago some obscure research worker discovered that the human eye persists in retaining an impression for $\frac{1}{16}$th of a second after the actual article seen has passed

MECHANICAL CONTROL BY THE PHOTO-ELECTRIC CELL

A number of years ago a more or less obscure investigator by the name of Hallwachs found that metal plates gave up their electrical charges when exposed to light. This photo-electric principle has found over two hundred industrial applications today in the form of the photo-electric cell. Here the photo-electric cell is used to control a toothpaste tube filling machine.

from view. Offhand, one would certainly fail to see how this delicate principle could be applied in a commercial way; but came the day when a genius decided that if pictures were flashed rapidly enough before the eye and in such a fashion that as one dissolved from view another would be there to take its place, moving pictures would result. Our movies of today are based on this sound reasoning.

A cat in a chemical laboratory many years ago had an accident which resulted in the discovery that silver bromide was sensitive to light; but it was years later that some genius applied the principle to photography. The principle of the cream separator was known to laboratory workers many years before a practical man came along and invented the centrifuge. We can indeed take many of our modern inventions and trace their sources back to the physics books. Heaven only knows when man found that metals expanded when heated. It was ages back that the Egyptian engineers used the principle of cubical expansion under heat in cutting off the rocks that went into the construction of the pyramids. This very same idea is today used in the precise control of temperature in connection with oil burners, electric furnaces, and all sorts of industrial heating. It is very simple indeed. A small piece of metal expands, makes or breaks an electrical connection, and the rest is controlled by an electric motor or a magnet.

When Thomas Edison was working with his early electric light, he found that a wire heated inside a vacuous space produced a condition that permitted electricity to pass in one direction only. Even the wiseacres of his time had no idea as to just what caused this, but the fact remains that all of our radio sets operate on this very principle today. To the practical man who can translate theory into practice there is an unlimited field in which he may apply his knowledge.

There is a constant and apparently unending supply of discoveries being made. One has but to be alert to find some apparently insignificant scientific law that may solve some of the industrial problems of the present time. Who, for instance, would have dared to think that a tiny wire moving in a magnetic field would some day make possible the talking moving picture? Faraday was amused in his laboratory by tiny effects that are today the basis of the generation and distribution of electric current. When the electrical experimenters of the early eighteenth century found that cats' fur and silk could be used in the generation of static electricity, they were unwittingly laying the foundation for a method that is now seriously proposed for the transmutation of matter.

The cautious, careful inventor always has a physics book at his elbow. At times the most remote effects can be applied to problems that for the moment appear to have no possible solution. It makes little difference how delicate an effect may be. It should always be kept in mind that we now have ways and means of amplifying delicate effects through the medium of the vacuum tube. A few years back it was found that a certain crystal of a certain common salt would have a minute electric charge developed within it if it were pressed between the fingers. This charge was so small that it was unable to produce any substantial physical or electric effects, and the work would have gone unnoticed had we not had the vacuum with which to amplify this current. Now the principle is used in radio-broadcasting microphones and to measure the internal pressures produced in large guns.

One of the greatest inventors and research workers that this country has ever known told the writer that he often went through his physics book to determine whether or not its pages held solutions to the many problems that he had at

hand. Not once but many times he came upon little effects which offered practical application, and several of his major contributions to the industrial welfare of the United States resulted from this study which to many inventors would have been considered almost a waste of time. A textbook of physics is essentially a textbook of invention filled with discoveries which, in their state of scientific rawness, would appear very remote to many of the problems of the day. It is the inventor's job to bridge the gap between basic fact and workaday application. Many huge fortunes have been piled up by men who have been keen enough to sense the possible from the apparently impossible; and the field is just as broad and offers just as many opportunities today as it did fifty years ago.

That a basic scientific law is successfully applied to one practical job does not mean that it cannot do others. The photo-electric principle is a good example of the versatility inherent in many such laws and effects. The photo-cell stops a locomotive when it passes a red signal; but it also counts electric ice-box units on a conveyor line and records, in a Buffalo college, the vibrations of a far-off earthquake. It has found over three hundred industrial and scientific jobs to do in the past five years and hundreds of jobs yet remain to be found by clever inventors.

Even the inventor who decides to devote his time to the perfection of toys can profit by a study of physics and pure science. Some years ago a very popular toy called "Radio Rex" made its inventor a tidy fortune. When one clapped one's hands before a small dog kennel, a little bulldog popped out. The trick was done by a simple little device sensitive to sound; but if that inventor had not known something of the physics of sound, the children of the United States would have been deprived of a wonderful toy and the inventor would

have been minus a large fortune. To one who has made a study of physics it will readily occur that we still have many scientific principles that can be made to do wonderful service in the toy industry.

If the practical inventor will for a moment turn his attention to the many processes that may be used for the recording of sound, he will not only greatly enrich his mind but he will be impressed and even awed by the different systems that have been perfected around principles that might at first thought appear very far removed from the world of everyday things. The writer mentions the recording and reproduction of sound because it represents one of the most beautiful examples of the application of pure science to practice that we have available.

Sound was first recorded by two German experimenters using tin-foil as the impressionable medium. A needle was connected to a diaphragm and the sound was communicated from the diaphragm to the impressionable record as it moved along. Reproduction was brought about by permitting the needle to play over the impressions that had been made in the tin-foil during the recording. It was a crude method and long patience in perfecting it was rewarded by raspy and almost inaudible whispers. Edison's chief contribution to the art was the recording of the sound on wax, which was a more sensitive and at the same time a less perishable medium. However, the purely mechanical method of recording and reproducing sound had inherent weaknesses that could not be overcome. Every avenue of approaching the problem in a mechanical way had been traversed, but the purely physical limitations of the method could not be eliminated. Only a comparatively narrow band of the middle register could be placed on the record and

less than this taken off. Consequently the music was deficient in both the lower and higher frequencies.

Then came the vacuum tube, that useful little device that is capable of amplifying both physical and electrical effects no matter how insignificant they may be. Research workers now saw the possibility of using an electrical microphone and amplifying the sound before it reached the record. All very well and good, but *how* could this sound be transferred to the record electrically; how were electrical vibrations going to be changed to mechanical vibrations capable of actuating the cutting stylus? The research workers harked back to an experiment originally performed by Faraday a hundred years ago and applied by D'Arsonval in the measurement of electric currents. This established the principle that a coil of wire in a concentrated magnetic field had a tendency to turn when an electric current passed through it. Why not, then, attach the cutting stylus to such a coil of wire and permit the amplified sound-carrying currents to traverse the coil? Would this not set the needle or stylus to vibrating in sympathy with the currents? It would, and the rest was quite simple. The vibrating needle was brought into contact with the impressionable wax records and a record of the sound was produced. That solved one of the problems.

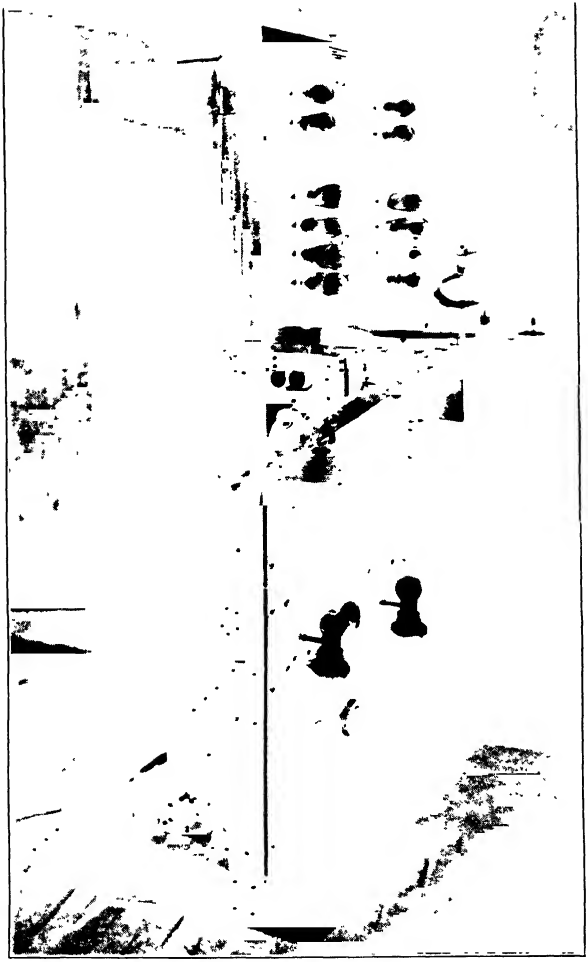
But how was the sound to be taken from the record? Here it was necessary to reverse the process; to change mechanical vibration back into electric currents. Those who have studied physics at all know that when a simple coil of wire is caused to cut through magnetic lines of force, a current will be generated in that coil of wire. That is the principle of the dynamo, which was also discovered by Faraday. It is indeed a far cry from a dynamo to a phonograph pick-up, but nevertheless the

two operate on precisely the same principle. Just as a coil carrying an electric current will move in a magnetic field, so will a coil moving in a magnetic field have a current generated within it. Hence, in developing a suitable magnetic pick-up for phonograph use, it was a more or less simple matter to attach a phonograph needle to a small coil of wire suspended in a magnetic field supplied by an ordinary horseshoe magnet. The current generated in the vibrating coil corresponded exactly to the sound-ladened current that cut the record. Naturally these currents generated in the electric pick-up were very weak and quite unable to actuate a loud-speaker; but then there was the ever-useful vacuum tube to amplify them.

This is not by any means the entire story of recording sound. Far from it.

Sound has been recorded photographically. As a matter of fact, it was this development that changed the talkies from an uncertain and rather questionable commercial venture to a solid and financially successful industry. In the first talkies, ordinary phonograph discs were synchronized with the moving picture projectors. One of the chief drawbacks to the system was the terrific breakage of the records during transit. The moving-picture studios received tons of broken records every month. It was obvious that the sound had to be incorporated with the film if the new idea was to live and prosper.

In the photographic recording of sound, advantage is again taken of Faraday's much-used discovery. The mechanism took on a slightly different form, but its basic nature was quite the same as the mechanism previously described. In this instance, a taut wire was suspended in a magnetic field in place of a coil, and this wire carried a tiny mirror. Thus when a current was passed through the wire, the wire would tend to move in the field and if this current was of a vibratory nature, such as



APPLICATION OF OLD PRINCIPLES IN THE ELECTRIC PHONOGRAPH

The parts of a modern high-powered electric phonograph were invented many years ago, but it is comparatively recently that these parts have been assembled for this purpose The little electrical pick-up used to take the music from the record has the same principle as that of the dynamo discovered by Faraday

would be the case if the current were modulated with sound, the wire and the mirror would be caused to vibrate in sympathy with the current. Naturally the sound was impressed upon the current through the medium of the well-known microphone.

A tiny beam of light played upon the mirror carried by the wire, and it is easy to see that this mirror caused the beam of light to assume a vibratory motion also. This tiny beam of light played on the edge of an unexposed moving-picture film tracing a line which has since become known as the "sound track." When the film was developed, it contained a faithful record of sound converted into photographic effects. But how was it possible to take this record and reconvert it back into sound?

Here the photo-electric cell came into use. A tiny beam of light was allowed to pass through the moving-picture sound track and strike the photo-electric cell. The intensity of this beam of light varied in correspondence with the sound record on the film. Consequently, the current coming from the photo-electric cell also varied, and thus the sound was again converted back into electric currents which were powerfully amplified and gushed forth from enormous loud speakers in the moving picture theaters.

This is not the whole story of the recording and reproduction of sound, but it covers the major developments. As a matter of fact, sound has been recorded in at least ten other ways, each method taking advantage of some little-known principle.

Many years ago Dewar, an English experimenter with liquid air, was looking for a container that would preserve such material. Being at a temperature that was several hundred degrees below zero, the air would boil furiously when it came in con-

tact with things at ordinary temperatures, and naturally enough it could not be held in captivity, so to speak. Someone before Dewar had made the more or less prosaic discovery that heat could not be transmitted through a vacuum. Dewar made a double-walled glass flask, pumped the air out from between the walls, sealed the glass, and found a method of preserving his laboratory specimens. He later employed still another scientific principle when he silvered the flask, for it was a well-known fact that heat waves were reflected in the same manner as light. Thus did he give his flask further thermal efficiency and protection.

When a workman eats his lunch today and pours his hot coffee from what has become known as the Thermos bottle, he never gives a thought to Dewar. In fact, the chances are that he has never heard of the man.

In the early days of electric ice-box manufacture the walls of the ice-boxes were stuffed with all sorts of insulating materials, some of them very costly and possessing the further disadvantage that they added greatly to the weight of the refrigerators. A cheaper, lighter method was urgently sought by the manufacturers. A German experimenter, keeping in mind the fact that heat waves are reflected by highly polished surfaces, built an ice-box which had a curtain of highly polished metal foil placed between its walls. Offhand, this might be considered as a poor substitute for some of the highly efficient thermal insulators, but the fact remains that a large number of the electric refrigerators in use in this country today have insulation of this sort.

The inventor never knows what little effect, what little-known law or delicate principle might come to his aid in the solution of certain problems. Therefore it should ever be his

desire to acquaint himself not only with the old and established physics but with the new work that is constantly going on. It often happens that these principles themselves suggest new inventions.

# CHAPTER XIV

## THE DEVELOPMENT OF LABOR-SAVING MACHINES AND DEVICES

A VERY large percentage of all patented machinery has been developed for the purpose of reducing or entirely eliminating human effort. While the social disturbances caused by this effort have been many and severe, the cry from industrialists still goes up for more and better ways of replacing workers with dumb machinery. Regardless of social implications, the inventor will do well to recognize the need; for inventions of this sort are as much in demand today as they were fifty years ago. Huge prices are paid for successful ideas because the manufacturer has direct proof that such things save him money—although when a new product is introduced, he must sit nervously by until a sufficiently long trial period has been passed through.

While most inventing requires a fair sense of economic values, this is especially so in connection with machines that are developed to replace human hands. A simple hypothetical case can be cited to emphasize this point. A machine is developed to replace the labor of two unskilled men. The machine does not increase production, it merely cuts down the human factor. The machine has cost $40,000 completely installed and the men whom it replaces are receiving $18.00 apiece weekly. A little loose figuring will show that such a machine should never have been invented. If a manufacturer spent $40,000 to install such a piece of equipment, he would have to figure

that this money would be called upon to earn 6 per cent per annum. Thus the machine would cost $2,400 a year. It would be replacing only two men and these two men would cost the company only $36.00 weekly, while the machine would cost $50.00 weekly, to say nothing of depreciation and upkeep. Little wonder that no sane manufacturer would give the matter a second thought. A very good part of a lifetime might be blundered away by some inventor who did not understand these simple facts.

The case just cited was very simple. All such figuring is not so elementary, especially in connection with complicated machinery, and the inexperienced man is advised to proceed with caution when contemplating devices of this nature. Some devastating mistakes have been made not alone by inventors but by large manufacturers, who have installed expensive automatic machinery only to find that they have been lured into an economic trap. The machinery had to be scrapped and operation had to be again turned over to the human hand.

The mention of the human hand recalls to mind some of the early inventors of labor-saving machinery who for some unknown reason felt that machinery of this type should mimic the fingers and the wrist. One of the patents signed by George Washington as President of the United States covered mechanically operated oars for a rowboat. It was a pretty crude device because its inventor was so influenced by the commonplaces of life that he could not extend his thinking beyond them. He was anything but a revolutionary creator, and it took Robert Fulton to show him how to eliminate oars. Here was a really new idea, a new principle. Ericsson later came along with the screw-propeller, which was a great improvement over Fulton's cumbersome side wheels, but when we look at such a thing today it is difficult to believe that it was fundamentally

a device to replace the oars of the slave galleys. The lesson to be learned here is that a labor-saving machine does not necessarily duplicate the movements of the human hand. It can take on a new and revolutionary form. In this kind of invention, it should be the inventor's object to break with the past as much as possible and to seek out a new principle.

The man who invented the carpet sweeper did not try to develop a machine that would provide an oscillatory movement for a broom. He used a revolving brush. The inventor of the vacuum cleaner went further and gave the art of sweeping the real fruit of genius. How curious it would be to see an egg beater swishing a spoon backward and forward in a bowl! Yet an inexperienced inventor might have tried this very thing.

The inventor of labor-saving machinery is today provided with many and wondrous elements with which he may work. Not only does he have a multitude of new mechanical movements, but he also has electrical apparatus that will replace the human senses of touch, hearing, and seeing. This new science has been called "electronics," and it involves the application of vacuum tubes, microphones, photo-electric cells, and grid-glow tubes. Already over three hundred industrial applications have been found for such devices, and we now have machines that are all but human in their actions. Articles are counted and sorted with the electric eye—sorted as to size, shape, and color. Two-ton billets of hot steel are shuttled under a rolling-mill, controlled by nothing more tangible than a beam of light. A new age of automatism has been very suddenly ushered in, and inventors are still rubbing their eyes and waking up to possibilities that were not dreamed of twenty years ago. Tiny whiffs of energy can be used to move and control mountainous machinery, and nothing appears to lie beyond the ultimate attainments of this new and fascinating magic.

With all of this perfection, however, it is still very possible that problems will be met in the design of new labor-saving machinery where the inventor will not be able to enlist any new or revolutionary principle and where he will be called upon to duplicate, as far as possible, the movements of the human hand. Design of this nature necessitates study of a very cautious and analytical nature and the student will learn much of the method employed if he will give some thought to the manner in which successful inventions along this line have been perfected. Perhaps one of the earliest mechanisms developed for the elimination of the human hand in a well-known operation was McCormick's self-binding harvester. The problem here was to devise a mechanism that would take the place of human hands in tying a knot in a cord whose ends had been mechanically brought around a bundle of grain. The first thing to be done was to select a knot that could be tied in the simplest fashion. The knot that the inventor selected was known as the bow-knot. In Figs. 1 to 6 it is seen how the inventor methodically analyzed his problem and produced a device that would replace the human hand. The problem was to find how this knot could be tied with the smallest number of fingers making the smallest number of simple movements. As anyone would ordinarily tie this simple knot, the movements would be so numerous and complex as to seem impossible of performance by machine. By constant study the inventor found that this knot could be tied by use of only two fingers on one hand and by very simple movements. The tying of a knot will best be understood by following the motions of the fingers in the photographs. Using the first and second fingers of the right hand, they are first swept outward and backward in a circular path against the two strands of cord to be tied. This is very clearly shown in step 1. The fingers con-

tinue their circular motion backward so that the strands of the cord are wrapped around the fingers, as illustrated in step 2.

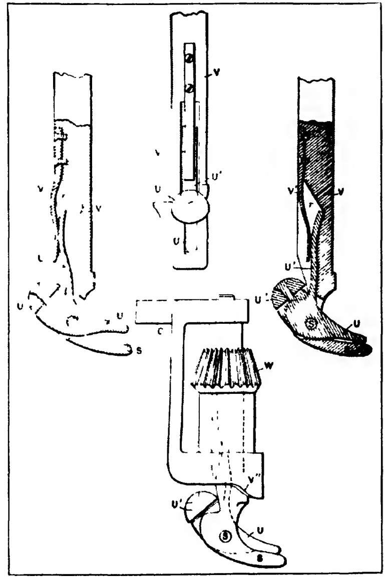
Continuing their circular motion, the fingers approach the strands of the cord between the twisted portion and a part of the machine that holds the ends of the cord, and the fingers spread apart, as shown in step 3, so that they can pass over and grasp the strands thus approached, as shown in step 2.

The fingers then draw back through the loop that has been formed about them, the fingers holding the grasped portion of the strands, as shown in step 4.

The knot is finished by the completion of the retracting movement of the fingers through the loop, thus forming the bow of the knot, as shown in step 5.

The inventor found that one finger could have a purely rotary movement, as if it were fixed on the arm and unable to move independently of the arm, and the movement being as if the arm rotated like a shaft; but the second finger must be further capable of moving toward and away from the first finger to perform the opening movement of step 3, and the closing movement of step 4 by which it grasps the cord. The inventor accordingly, from his exhaustive analysis of his problem and his invention or discovery of the proper finger movements, had further only to devise the very simple mechanical device, illustrated in the diagram, to replace the fingers.

The index finger of the hand is represented by the finger *S*, which is integral with the shaft *V*. The second finger of the hand is represented by the finger *U*, which is pivoted to the first finger by the pin *S*. The grasping movement of the finger *U* is accomplished by a spring *V′* bearing on the shank *U′*, and its opening movement is caused by the travel of an antifriction roll *U″*, on the rear end of the pivoted finger, over a cam *V″*, on the bearing of the shaft. The shaft is rotated by



DEVELOPMENT OF THE SELF-BINDER KNOTTING DEVICE

The analysis of the movements of the hand in making a simple knot resulted in the development of this device having but two metallic fingers. Not only did the inventor solve his problem, but he simplified it by eliminating superfluous parts.

the turning of a bevel pinion *W* on the shaft through the action of an intermittent gear. The necessity of drawing the fingers backward to accomplish the movement between Figs. 46 and 6 was avoided by causing the tied bundle to have a motion away from the fingers as it is expelled from the machine, the relative motion between the fingers and the knot being the same as if the fingers drew back.

Thus the accomplishment of a seemingly almost impossible function was rendered mechanically simple by an evolution from the human hand, after an exhaustive and ingenious analysis of the conditions involved.

It will be seen from the example given that the constructive part of inventing consists of evolution, the association of previously known elements in new relationships (using the term "elements" in its broadest sense). The results of such new association may themselves be treated as elements of the next stage of development; but in the last analysis nothing is invented or created absolutely out of nothing.

It must also be apparent that pure reason and method, while not taking the place of the inventive faculty, can clear the way for the exercise of that faculty and very greatly reduce the demands upon it.

# CHAPTER XV

## FINDING THE RIGHT PATENT ATTORNEY

EVERY criminal knows who is the best criminal lawyer in his community, and thereby establishes an object lesson for every inventor. If inventors used the same care in their choice of legal talent, they would save money and at the same time come through the Patent Office with better patents. After all, the nature of a patent and its ability to withstand attack depends entirely upon the skill of the attorney unless the inventor knows all of the tricks of the trade and is himself an expert in the drawing of patent claims, which does not happen once in a thousand cases. A patent may be the proverbial scrap of paper or it may be a tower of legal strength capable of moving the Supreme Court of the United States to rally to its defense.

There is no great amount of skill involved in merely putting a patent through the Office. Not a small number of patents are worthless, or less than worthless, if such a thing can be, for not only do they bring bitter disappointment, but expense in hopeless defense if they are infringed and the inventor attempts to protect them. That a patent issues has little bearing on its validity. It may cover an important new work and it may, given proper protection, be worth a great deal of money; but if it is poorly framed, it may bring only heartaches to its owner. Every patent issues in the same physical form and takes on a very important appearance, whether it be a mongrel or a thoroughbred.

Countless slipshod cases pass through the Patent Office yearly. The attorneys who handle them are more interested in the collection of their fees than they are in the establishment of bomb-proof claims. Such patents glide through the Office with disarming rapidity, and the inventors may be highly pleased with the ease and speed with which their cases are handled. Trusting souls that they are, they feel that they have had an able and skilled man to work for them. The Patent Office examiners are not employed to point out mistakes in patent applications unless those mistakes violate some rule of the Office. If they see a weak patent on its way through the Office, they treat it just like any other patent, save that they might "laugh up their sleeves."

If a group of patent claims are not opposed or contested in any way, either one of two things has happened. The patent is a masterpiece, or it has been prepared with one eye on fees and the other eye on unsuspecting prospects. The chances that the patent is a masterpiece are about ten thousand to one. If the patent issues as a masterpiece, it is because the writer of the patent has struggled to obtain everything for the inventor that he thinks is rightfully his; and in so doing he is bound to draw fire from the examiners, who will stick by their guns. Hence the perfect or near-perfect patent does not often issue easily.

The inventor can be easily misled in such work, and especially in connection with the prosecution of patents that attempt to cover some very weak idea. The examiners are always on guard for such patent applications because many of the quack attorneys will attempt to put through cases that do not have "a leg to stand on." The fact that the Office might eventually rule against granting a patent does not deter them. By this time they will have collected a fat bundle of

fees, many of them for "special" work. Had any real and conscientious patent attorney investigated the prior art in back of such ideas, he would have unhesitatingly advised against any action.

The art of the quack attorney is black and offensive. He employs many tricks to separate honest, hard-working men from their money. As often as not such attorneys will write a long series of more or less ridiculous claims around an idea that should never have been the subject for a patent application in the first place. The attorney knows that the average untrained inventor feels that the more claims his patent has, the greater will be its strength—though just the reverse is more often true. The attorney knows further that the examiner in the Patent Office will violently oppose at least half of the claims prepared. This is just what the framer of the claims wants, because this will give him the opportunity of convincing the inventor that these claims are important and that every effort should be made to jam them through the Office. Hence the attorney will suggest that he be authorized to apply for a reconsideration of the claims, which will involve another sizeable fee. The inventor may have started out under the impression that his simple patent was going to cost him about $125; but if he does not exceed this figure he can rest assured that he has been in the hands of an honest person. He will not be told that his patent will be guaranteed for $125, but rather that the average price does not run much beyond this for simple cases.

It is surprising how many extras may be involved in a patent case. The writer recalls an application filed by a chemist who was a good chemist with an old idea. He did not know that his idea was old, however, and he applied for a patent on it through the offices of one of the so-called "patent factories."

A year and a half later he was a sadder and wiser man minus a patent and $610 in actual cash.

This may be pretty dreary reading for the man who proposes to spend his life in this field, but the sun does shine. We have many excellent and capable, to say nothing of honest, patent attorneys in this country, if the inventor will but take the time to find them. On the whole their quoted prices for obtaining a patent may be higher than those of the attorneys who prey on inventors; but in the long run the total costs will be lower than they would be if the application reached the hands of one of the quacks. What is more important, their advice to the inventor will come straight from the shoulder. These men are interested primarily in their standing and reputation, and this can be preserved only by skilful and efficient work. Such attorneys usually have a list of large manufacturers by whom they are constantly employed, and a fifty dollar extra or unjustified fee is small in comparison with their yearly income.

Many inventors have written to the writer asking him to help them find an attorney with whom they can deal without danger of having their inventions stolen. This is a naïve request, for precious few ideas have ever been appropriated under these conditions. As a matter of fact the writer has never heard of a single case of this nature, and the risks involved are practically nil. To give the devil his due, it must even be admitted that the quack fraternity refrains from this practice for, above all, they must preserve their questionable standing with the Patent Office. They are constantly facing the prospects of disbarment as it is. The Commissioner of Patents has it within his power to refuse the applications of attorneys who have violated the rules of decency.

Twenty years ago the Commissioner of Patents, driven to desperation over the blatant activities of the attorneys who

spread loud advertising before the eyes of the readers of the popular technical magazines, made certain important rulings to curb the enthusiasm of this class of gentry. These were the days of the "needed invention" appeal to the ingenuity of America. If an inventor sent for the literature of these men they would be supplied gratis with a list of the ideas for which the world was patiently waiting. One of the star baits on such lists happened to be a non-refillable bottle, and the result was that for a period of years our Patent Office examiners were besieged with applications covering bottles of this type. Perhaps this art now contains at least a thousand patents; and this, together with several other inventive spellbinders, resulted in a great volume of business for the attorneys who shouted aloud. Other practices were also frowned upon by the Patent Office officials; and finally the goose that laid the golden egg, though she was not entirely killed, at least had her wings clipped.

Came the day when the advertising matter of the patent fraternity had to pass under the eagle eye of the Commissioner of Patents, who insisted upon certain decorum more consistent with the dignity of the profession. The real members of the profession hailed the ruling with delight; perhaps no edict ever issued by the Patent Office pleased them more, for the odor left by these questionable practices was slowly permeating the whole field. The land was filled with disappointed rainbow chasers who had been inspired to the point of spending their last dime in patenting all manner of contraptions from rocking chairs for hunchbacked people to combination balloons and submarines. Funny things, to be sure, but what a great deal of real tragedy they represented! Many children had to go undernourished that father might have his fling at fortune.

Good patent attorneys are hard to find, not because they

are so few in number but because they receive such little publicity. A few of them do advertise modestly by the display of a professional card, but most of them do not need to advertise. They are too busy filing patent applications for wise inventors and corporations. Theirs is a dignified and honest calling attended by a full knowledge of social responsibility. It is not enough that they know that a patent can be obtained. An idea must possess the prospects of being the basis of a good patent before these men will advise action.

A few inventors go to a local and general practitioner with their ideas. While it is true that an ordinary attorney has the right to file patents, he is not the man to seek for protection. The chances are that he has forgotten most of his patent law, and he is little qualified to understand the purely technical side of a simple invention, let alone a complicated one. If other business is a little slow with him, he is very apt to be tempted beyond his endurance; and such things are to be avoided. Such a man may do his level best to serve an inventor, but his level best will not be enough. However, the inventor can always appeal to local attorneys for advice, and they quite often know of good patent attorneys whose addresses they will gladly provide. If this cannot be done, the inventor can appeal to a local corporation and the chief engineer, who doubtless has had experience with patent matters, will be in a position to name a capable attorney.

Once the inventor has found a man who is to help him protect his invention, he must lay his problem before him with complete confidence and candor. Not the slightest detail should be overlooked, and the coöperation should be complete. The more the inventor coöperates with the attorney, the greater the speed and the better the resulting patent.

# CHAPTER XVI

## THE PREPARATION OF PATENT CLAIMS

THE introductory matter of each patent is called the "specifications," and therein the general outline of the invention is given, together with the use for which the invention was intended. The claims for the invention appear in the latter part of the patent papers, and it is upon the framing of the claims that a patent either stands or falls when it is subject to litigation. In the claims the invention is outlined in such a way that there can be no mistaking what the inventor had in mind when he applied for his patent. It is in the preparation of such claims that the greatest skill is required on the part of the attorney.

While this chapter can do little but touch upon the broad essentials of claims, it can also make inventors conscious of the importance of this part of the protection that they receive from the Patent Office. Claim authorship usually requires years of study, and not every attorney who practices patent law is capable of writing claims that are safe from the unmerciful analysis of a court. Nearly any inventor, to say nothing of attorneys, could write claims that would pass the Patent Office; but that would not mean that the claims were sound or that they would protect the invention should it be the subject of a lawsuit for infringement.

The danger of such situations can be more fully realized when it is known that our Patent Office examiners will usually

fight strong claims but will stand aside and permit the passage of weak claims. In short, they will fight a claim which they think covers too much, but they will never interfere with a claim that covers too little. Thus the admiration that a patentee has for his attorney when he pushes a patent through the Office at high speed is not usually justified by the facts of the case, although this should not be taken to mean that all such fast-moving patents are worthless. It simply means that the chances are against the passage of really strong claims without strong opposition from the Patent Office and subsequent delay. At times highly skilled attorneys are capable of performing such miracles, but cases like this do not happen very often for the simple reason that smart attorneys do not want them to happen. The reason is obvious.

Patent claims, fortunately, are not written to please the Patent Office examiners or to spare them any labor. On the contrary, they are prepared to precipitate a gentlemen's argument, so to speak. It is natural that the patent attorney will try to claim as much as possible for his client, and it is furthermore natural that the Patent Office examiner will do everything possible to limit those claims to what he thinks is the actual invention. The purposes of the participants in the argument are diametrically opposed.

Really clever lawyers plan their campaigns with great ingenuity. Before writing their claims they study the prior art religiously, and they will skirt around the edges of this art with consummate skill in the preparation of their claims. Furthermore they will often prepare a set of claims that they are sure will never survive the first glance of the ever-alert examiner. The claims will be far too broad, and they do nothing but set the examiner to work to show why they should not be allowed in their present form. That is just what the at-

torney wants. Each examiner in the Patent Office is a specialist in his line and knows the art in which he performs better than does the attorney, who perhaps is not a specialist. Faced with an application for broad claims, the examiner immediately scurries about the Patent Office and digs out references that the attorney might never have heard of for the simple reason that they involved inventions which he did not associate with his field. It is, for instance, quite possible to find the same patented mechanical movement on a typewriter as on a cream separator. The filing of these broad and obviously impossible claims serves the purpose of smoking out the prior art, and it is a smoking out that cannot be obtained with an ordinary search of the Patent Office records.

Now the attorney in charge of the application becomes provided with data which will be a great help to him in the framing of the real claims for the patent, claims which he thinks will have a chance of convincing the examiner that they should be allowed. The examiners on the whole are not unfair and they are called upon to protect the interests of other inventors who hold patents and of inventors to come who will apply for patents at some future date. The broader a claim is, the more it covers, until a point is reached where it will gather in ideas quite foreign to its purposes.

The narrow claim is also to be guarded against, and the famous Selden automobile patent offers a very illuminating reference. In the early days of the automobile industry every manufacturer had to pay the inventor, Selden, a handsome royalty because he had patented the rather obvious idea of driving a vehicle with a gasolene engine. Henry Ford refused to pay this royalty and was finally brought into court to defend himself. Selden's attorney, for some reason perhaps best known to himself, had claimed a vehicle driven by a two-

cycle gasolene engine. Henry Ford, as well as most of the other manufacturers, was then using a four-cycle gasoline engine; and the court finally ruled that he was not infringing Selden's patent. That was the end of a million-dollar idea. Selden had not claimed enough, or his claims were too narrow. If he had used some term like a "gasoline-powered unit," he might have won his lawsuit. He was too specific for his own good.

On the whole, inventors insist upon claiming too much rather than too little. While it is well to attempt to obtain a broad, sound claim, it is also rather dangerous, especially in the light of modern court decisions, to claim too much. If such claims do get past the guard of the Patent Office examiner and issue, they are apt to tread on other people's toes; and when they do this they invariably lead to lawsuits. No poor inventor wishes to face a situation of this kind, and the court is very apt to rule in disfavor of the broad claims.

It would appear here that the inventor is squeezed in between two hostile forces. If he claims too much, he is very apt to lose his case; and if he claims too little, as did Selden, he is also apt to lose. What can be done? Is not the whole situation more or less hopeless? It is hopeless for inventors who have hired attorneys who do not know their business. By luck alone they may survive a lawsuit or an interference case in the Patent Office. On the other hand, excellent claims are being granted by the Patent Office every day because those claims are being prepared with care and caution by men who know how to write them. These men do not operate "patent factories" wherein young and inexperienced graduates from law school are turned loose on the delicate matter of preparing claims with the grand salary of twenty-five dollars a week.

Inexperienced inventors too often think that long and wordy

patent claims are the best because they describe the invention thoroughly and are apt to meet their ideas of broadness in this manner. This is the opposite extreme of what is actually true. It is the short, accurate claim expressed in a few words that go directly to the heart of the matter, that counts. Some of the strongest claims ever written, as subsequent court decisions have proved, consisted of but one short sentence composed in masterly style.

Some of the quack attorneys flatter an idea and please their clients by writing a long series of claims. These claims can be weak and inoffensive and the Patent Office examiner may pass them without question. Hence the inventor feels very secure when his attorney writes to him and proudly announces that he has engineered no less than sixteen claims through the office. The number of claims granted has little to do with the protection of an invention unless those claims have substance. They can amount to nothing more important than useless ornamentation.

The reader should not jump at the conclusion that the one- or two-claim patent must be the best or the strongest. One or two claims can be drawn just as weakly as a dozen. It does happen, however, that many excellent attorneys set up a series of claims as a matter of precaution. They are what might be called graduated claims and, if the judge in a court rules one out, the inventor covers his retreat with another one. The chances are that the judge will find one or more claims in the group that will bear up under the interpretation that he places upon them; whereas the rejection of a single claim leaves the inventor no alternative other than an appeal to a higher court.

In short, it might be said that the inventor receives what he claims by the strictest legal interpretation of the meaning

AN EARLY APPLICATION OF ELECTROLYSIS

The production of metallic sodium by the electrolysis of sodium hydroxide, an experiment which was first performed by Sir Humphry Davy in 1807 and eventually led to the development of the large electrolytic cells now used for this purpose. This was one of the first experiments that showed the relationship existing between chemistry and electricity.

of the claims. And the fact that a Patent Office examiner has passed a set of claims does not mean that even a low court will agree with him. Even at this late date, after a patent has issued, its claims can be declared invalid and the inventor can be called upon to fight this decision all the way to the Supreme Court of the United States.

The wise inventor will not feel satisfied with the information imparted in this brief chapter. He will wish to continue with his study in the works of the various authorities; for it is only through a keen understanding of this work that the inventor finds himself able to coöperate with his attorney in an intelligent manner. Attorneys are anxious to coöperate with their clients in the preparation of claims, but are often prevented from doing so because the client is blissfully ignorant of the part he is to play.

# CHAPTER XVII

## FOREIGN PATENTS

INVENTIONS may be patented in other countries besides the United States. However, it is not always advisable for an inventor to seek protection in another country. Much depends upon the patent and the economic condition existing in the country where the invention is to be patented. In many cases it is a waste of time and money to seek foreign protection. For instance, an inventor may have invented an ice-cream freezer. Ice-cream is used very little in foreign countries with the exception of Canada. Therefore it would be worse than folly to make a large investment in foreign protection on a device that would not find wide application.

The inventor must use his own judgment in cases of this nature. If he is not sure, he should investigate the economic situation surrounding the possible use of his invention in foreign countries before he decides to obtain foreign protection. It is the practice of many quack patent attorneys to make an effort to impress every inventor with the necessity of foreign protection, regardless of the device that he has to protect.

Foreign patents are not as expensive as might be supposed. In any event, the first and most important thing for an inventor to do in seeking foreign protection is to find an attorney of integrity and standing.

Foreign patents must, with few exceptions, be filed twelve

months from the date of filing in the United States application. Foreign patent laws are very different than our own. Some countries grant patents to the first applicant, whether he is the inventor or not. This system, of course, encourages piracy, and many honest inventors are robbed of their ideas by unscrupulous men. In this country priority is the first consideration. If an inventor can prove that he was the first man to have the idea, then his claim invalidates all other claims, whether they are filed in the Patent Office or not. Unfortunately, many of the foreign countries maintain no searching systems and therefore grant patents without any preliminary examination to determine originality and priority. This condition allows any unscrupulous patent attorney to obtain large fees for filing a patent in countries where the cost of filing amounts to very little. In some cases this is done after the United States Patent Office has refused to grant a patent because of references found in the search. Of course, such patents are absolutely worthless.

Another outstanding feature of foreign patents is the matter of taxes. In nearly every case some kind of a tax is required on the patent. Often a yearly tax has to be paid, while the initial expense in taking out the patent may be small. Before the Russian revolution, over $1,000 was necessary to patent an article in Russia. The fees or taxes imposed were spread over a period of fifteen years.

In some countries the governments require that the patent shall be worked out in practice within a certain number of years, and that if this is not done the inventor shall forfeit all rights to his patent. In some other countries the government decrees that it shall have free use of all patents submitted to its patent office.

There are about seventy-five countries that have provided

patent laws. These laws vary greatly. Some are so loose and ill-advised that they offer the inventor practically no protection, or at least a protection not worth paying for. Among the nations that grant patents without preliminary examinations or patent-office searches are France, Italy, Belgium, Spain, Portugal, Switzerland, Mexico, Brazil, and Tunis. It is a very simple matter to obtain patents in these countries. Consequently it is also usually an easy matter to prove that patents are invalid in these countries if the article patented is not original or if the invention was claimed too broadly. When a patent is refused in these countries, it is useless to carry the case further and foreign protection is not advisable.

The important countries supporting a rigid patent-office search system are Germany, Great Britain, Canada, Austria, Denmark, Sweden, Norway, Japan, Liberia, and Argentina. In Canada and Germany there exists a system which is equal to that supported in the United States. It is well to keep in mind that maximum protection is offered by the United States Patent System.

Many foreign countries will not issue patents if technical articles have been published in other countries concerning the article to be patented. For instance, an inventor produces a new article in the United States, patents it, and publishes the results of his work. This procedure will interfere with patents in some other countries. For instance, in Germany, the patent would be refused. In fact, the publication of the United States patent in the *Official Gazette* would be sufficient to render the claims invalid in Germany. There is a case on record where the Wright Brothers' airplane patents were declared invalid in Germany merely on account of a technical publication reference.

In France, Germany, Belgium, Portugal, and a few other

countries the first applicant for a patent, whether he is the inventor of the article to be patented or not, is recognized. In Great Britain and Austria, the law states that a patent taken out under these circumstances must be transferred to the real inventor, regardless of the grants made to the party who is not the inventor.

In some countries it is required that the inventor have his patented article manufactured within a certain period of time. Oftentimes compulsory licenses are required which are used to prevent the non-use of needed inventions. In a few countries special favors are shown to American inventors. This has been brought about by treaties which the United States has made with these countries. In the year 1909, this country made a treaty with Germany through which inventors are allowed special favors.

In some foreign countries it is required that the applicant place himself under the jurisdiction of the laws existing in that country. This is usually done by appointing a representative in the country. Patent lawyers sometimes have the necessary connections and can make the proper appointments.

In certain countries some articles cannot be patented. For instance, medicines and foodstuffs are not patentable in Germany, although the machinery used in their manufacture may be covered by letters patent.

In some countries it is possible to make additions or improvements to patents after the original patents have been granted. This is done by the payment of additional fees, which are usually very nominal.

In the average case the inventor should seek protection in Great Britain, Canada, Germany and France. This advice is given, of course, on the assumption that the patented article will find wide use in the countries mentioned. In general, a

patent that finds use in the United States will apply to Canada, since the habits of the Canadian people and their economic conditions are very similar to those of our own country.

When German patents are granted, the patent grant can be considered extremely valuable, since great care is taken to prove originality and priority. In Germany a publication of the patent is made before the patent is granted. This is done to allow protests to be made if the article is not original with the person seeking protection.

The results of the International Convention for the Protection of Industrial Property has been outlined by Philip E. Edelman, author of *Inventions and Patents,* as follows:

This union is one of vital importance to inventors and manufacturers. It embraces the United States, Great Britain with New Zealand and Commonwealth of Australia, Germany, Austria, Hungary, France with Tunis, Algeria and French Colonies, Swiss Confederation, Denmark, Sweden, Norway, Belgium, Netherlands with Dutch East and West Indies, Spain, Portugal, Turkey, Servia, Mexico, Cuba, Brazil, Chili, Ecuador, and a few others.

The Convention has done much to bring about a standardization of patent procedure in spite of the varying laws in each case. Its work has been of great importance and it is hoped will eventually lead to uniform patent laws in the leading countries. The requirements of many laws have already been modified by provisions in the Convention agreements. The main points are:

(1) An applicant is given a period of twelve months during which he enjoys the right of priority for the purpose of making applications in any other countries to the agreement of other than that filed.

(2) A subsequent deposit made during the twelve-month period in any country to the agreement cannot be declared invalid by acts performed during the interval, as publication, or working, or sale.

(3) Patents applied for in the different contracting states are independent of patents for the same subject matter obtained in any

other country. [Note.—Countries not in the Union generally provide that the patent in that particular state lapses at the same time another patent for the same subject-matter lapses, even if this takes place before the full term is completed.]

(4) When legislation prevents seizure on importation, prohibition of importations may be substituted. [Note.—The leading countries, including the United States, generally allow importation.]

(5) A patentee in each country of the Union does not suffer forfeiture because of non-working until after the minimum of three years after the application in the country concerned and in cases where he does not justify the reasons for this inaction.

(6) Applications under the treaty must be modified to comply with the individual formalities of each country. [Note.—The procedure in many countries is similar and duplicate documents can be used in some cases. Some countries allow of a choice of languages.]

In general, the patentee enjoys almost as great protection from infringements in foreign countries as in the United States. In some countries he has even greater rights in this matter. A few general notes concerning infringements follow:

France provides aggressive measures for the provisional confiscation of infringing articles. Germany, Mexico, Brazil, and others make the violation of patent rights punishable by fines.

Canada and England provide for civil procedure as in the United States. (A penal servitude of three years may be imposed for infringement in Japan.)

In most countries the proper marking of the patented article is regarded as essential in order to notify the public. In Germany this is *Patent, D. R. P.* (*Deutsches Reichspatent*). In France it is *brevet* and *S. G. D. G.* (*sans garantie du gouvernement*). In France the patentee is liable to be fined for using the mark after the expiration of the patent. Other countries generally allow such use without liability.

Foreign countries generally provide a fine for the fraudulent use of the word "patented." In Canada this is $200, in England $25, and in Germany $250. France requires that taxes be paid before an assignment of the patent rights can be recorded. In England the owner of a valid patent is given noteworthy protection. An infringer cannot avoid infringement by dropping an unimportant element of a claim in his combination; and the patentee is not required to mark the article "patented" in England.

Canada provides a penalty for non-marking of patented articles, but this does not prevent the collection of damages in case of infringement. In general, the leading foreign countries provide equal or greater protection against infringement than the United States. The procedure in Germany in infringement suits is particularly direct and effective.

The foregoing is only of a general nature, and since the subject is a large one, it is not complete. It is thought that these points will be sufficient for ordinary purposes and the reader is referred to legal advice, encyclopedias and *Foreign and Colonial Patent Laws*, by W. C. Fairweather. Inventors can also get information from the U. S. Consular Service with respect to particular countries.

Foreign patent rights are often sold through brokers. The principles involved do not vary materially from the procedure in selling domestic rights, and too much care cannot be taken in choosing a reliable representative. Domestic manufacturers, with growing foreign trade, can be interested in the foreign rights to inventions in their line. The subject is worth the consideration of every patentee.

In the following list there are given the names of countries having a patent system and the approximate cost of obtaining protection in these countries.

| | |
|---|---|
| Argentine: | |
| 5 years | $110 |
| 10 years | 125 |
| Australia | 100 |
| Austria | 100 |
| Bahamas | 175 |
| Barbados | 135 |
| Belgium | 40 |
| Bermuda | 160 |
| Bolivia | 150 |
| Brazil | 175 |
| Ceylon | 125 |
| Chile | 190 |
| Colombia: | |
| 10 years | 175 |
| 15 years | 200 |
| Congo Free State | 70 |
| Costa Rica | 120 |
| Cuba | 125 |
| Denmark | 90 |
| Ecuador (5 years) | 250 |
| Egypt | 85 |
| Finland | 100 |
| Germany: | |
| Model patent | 50 |
| Regular patent | 100 |
| Gibraltar | 175 |
| Granada | 160 |
| Gautemala | 225 |
| Holland | $140 |
| Honduras | 170 |
| Hungary | 80 |
| India | 80 |
| Italy | 75 |
| Jamaica | 180 |
| Japan | 100 |
| Leeward Islands | 250 |
| Luxembourg | 50 |
| Mexico (20 years) | 100 |
| Newfoundland | 125 |
| Nicaragua | 185 |
| Norway | 100 |
| Panama (5 years) | 200 |
| Paraguay | 200 |
| Peru | 190 |
| Philippines | 20 |
| Roumania | 90 |
| Russia | 120 |
| Spain | 85 |
| Sweden | 100 |
| Switzerland | 80 |
| Trinidad and Tobago | 200 |
| Tunis | 100 |
| Uruguay (9 years) | 180 |
| Venezuela: | |
| 5 years | 165 |
| 10 years | 220 |
| 15 years | 300 |

## CHAPTER XVIII

### HOW INVENTIONS ARE SOLD

THE selling of an invention amounts to the parting of the ways for the inventor. Here he must leave his workshop or his laboratory and the field of science and mechanics to step into that cold and very real world of business, a world where dreams must square up to basic factors. It is at this point in his work that the inventor must feel strange and ill at ease, for he is at last brought face to face with the bogies that he has heard about and dreaded for many years. Little wonder that he is resolved to protect his invention as fiercely as he can. Little wonder that his sense of protection is stimulated to a point where he often becomes an object of pity and a prey to flattery.

But where is the buyer? How will he be found? How will he be approached? How will he be chosen from a group of twenty or thirty manufacturers who might be in the market for the new invention? These are some of the preliminary questions that must be answered. Naturally, if an invention possesses the possibility of making money, the buyer will not be difficult to find; but here the inventor must make sure that he is the right and most logical buyer, the buyer who will be able to pay the largest royalty and who controls most of the market to which the invention must be sold.

It would seem that this latter thought would be one of the first to enter the inventor's mind, but it is not. Fifty years ago,

a manufacturer was capable of producing almost anything that came along. He had a machine-shop, a foundry, and a sales force; and he would often take a chance with a new idea no matter how little he knew about the market for that idea. Those days have passed forever. Manufacture has become highly specialized. The jack-of-all-trades producer has long since gone by the board. It is a day of intense specialization and there is the one *best* manufacturer for each new invention.

The first rule, if there is a rule in the selling of an idea, is to aim high and to pick out the largest and the most financially powerful member of a group of manufacturers. It costs no more to contact the largest than it does the smallest. The ambition of every electrical genius is to sell the rights to his patent to the General Electric Company; and this is as it should be, not only because this company is notoriously fair to its contributors but because it is also the largest unit in the business that is thoroughly "invention-conscious." The inventor starts in at the top and works his way down in the order of the financial responsibility of the possible buyers.

It is not unusual that a smaller producer will offer more alluring terms than a larger one, and it sometimes happens that inventors will be misguided in this, feeling that the prospects for immediate returns are better. But what of the long term? The seller should not lose sight of the fact that the big producer controls a larger slice of the market and that a smaller royalty and larger production is apt to be much more beneficial than a larger royalty and a small production.

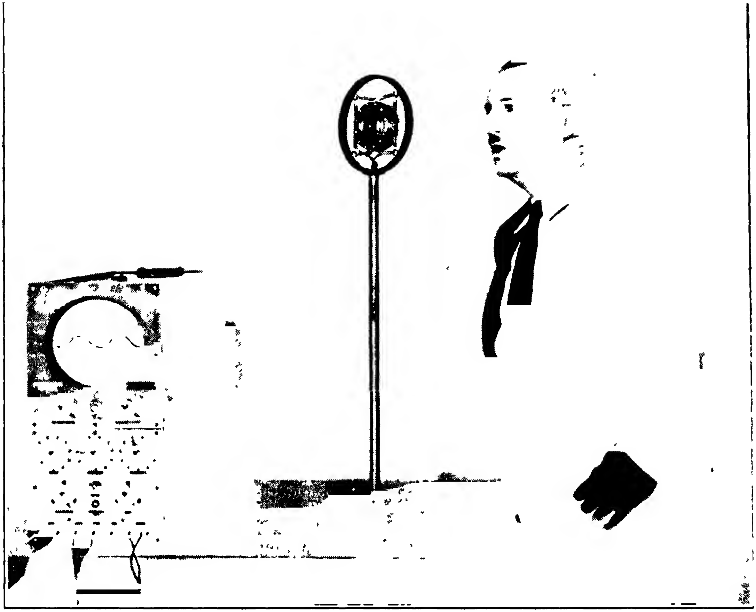
One of the real dangers in seeking a buyer is to avoid the unknown or the weak manufacturer who will often offer the inventor a fabulous royalty wholly out of proportion to the value of the idea. In the case of a manufacturer who is just one

jump ahead of the sheriff, this logic is not difficult to understand. It is the old case of the drowning man grasping a straw. A good and new idea might appear to have the prospects of pulling a half-bankrupt concern "out of the red," and in its desire to have rights to such an idea it may over-extend itself. No inventor who has ever had the sad misfortune of signing a contract with such a producer will ever repeat the mistake, especially if that producer has later passed into the hands of receivers or into bankruptcy. This passing will mean that his invention will be tied up with the liquid assets of the company and many months, to say nothing of years, may go by with a perfectly good idea gathering moss under court procedures.

It is obvious that the inventor must be very sure of the financial standing of those with whom he does business, either in the way of individuals or corporations. In the case of corporations, we have agencies to which we may appeal for financial ratings, and these ratings will be supplied at small cost or may be had from such standard works as Dunn and Bradstreet's official publications, which are usually available at the local bank. The inventor's banker will be glad to interpret these ratings for him and to offer him sane guidance.

While it is a very simple matter to find a possible buyer for many things, it more often happens that an invention is so highly specialized that possible manufacturers are not known. An examination of a weekly issue of the *Saturday Evening Post* will reveal the names of at least fifty large and powerful producers for certain ideas that would have prospects of national distribution; but what about the invention that involves a machine for electroplating aluminium or stitching shoes?

In every local library there will be found trade journals and trade reference books containing the names of classified manufacturers from which the inventor may find possibilities. After



ANALYSIS OF THE HUMAN VOICE

Here a singer is having his voice analyzed by a special oscilloscope. While this is a wonderful modern invention, it involves simple principles that were discovered years ago.

finding the names, his next chore will be that of classifying them according to their Dunn and Bradstreet ratings. Then, if the local library is so small that it cannot offer help in this matter of accumulating the names of possible buyers, the inventor is always privileged, as a citizen of the United States, to appeal to his Department of Commerce, Washington, D. C. If he will state his case clearly and tell just what he wants, such information will be supplied without charge.

Assuming that the manufacturer is found, the next step is that of finding the right person in the organization. In the case of large producers of technical equipment, it is fairly safe to address one's letters or to appeal in person to the research director or chief engineer, who will be quickest to see any possibilities that a new device might have. If the party addressed shows a complete knowledge of the new invention, the inventor does not need to be surprised; it is part of the work of such men to watch the weekly issues of the *Official Gazette* to see what is new and to have some idea as to what their competitors may be doing.

But if these men know about the invention, why have they not already contacted the inventor; why does the inventor have to go to them? That may be part of the business philosophy employed by the concern in question. To go to an inventor shows a degree of interest and places, or might place, the inventor in a bad frame of mind when it came to the matter of discussing prices. To be contacted by the inventor puts the inventor on the offensive. A small point, indeed, but often a very important one.

If the chief engineer can be convinced of the utility of a new idea, the inventor can count on a friend at court. This does not mean that the idea is as good as sold, but it does mean that it is in the hands of a sympathetic man who understands

it. Of course, if he is wise, he will not reveal too many of his thoughts to the inventor, and the inventor might even leave, after the first visit, with the feeling that the engineer was not interested. This may or may not be strategy. Buyers seldom enthuse, whether they be buying a pair of socks in the five-and-ten-cent store or a new invention worth a million. It is human and it is good business.

In meetings of this sort, it behooves the inventor not to talk too much and to be sure that he knows what he is talking about. If he displays a poor knowledge of his subject and is given to exaggeration, he will be put down as a blow-hard with poor judgment, and this will be reflected in the terms upon which any subsequent agreement is based if matters reach this stage. Nor should the inventor make the mistake of asking the first party interviewed what price the invention will bring. This is silly and impertinent, to say nothing of its being entirely premature. This man may have something to say about the ultimate purchase, if any, but he is not authorized to mention possible price. It is simply the inventor's part to place the ideas in this man's hands, to state his case in as conservative a manner as possible, and to graciously retire from the scene.

The part of the party interviewed is merely that of preparing a report on the matter which will be submitted either to the sales manager or to one of the vice-presidents who, in turn, will introduce the matter to the president of the company; and the next logical step is the consideration of the board of directors, provided the idea is good enough to demand such attention. If it is acted upon favorably, the inventor will be asked to make another call during which he will be requested to interview a higher official of the firm, perhaps in company with the chief engineer. Smart inventors take their

lawyers to such conferences, but not every struggling beginner can afford such luxury.

Regardless of the number of people present, the seller of the invention will do well not to talk too much and not to commit himself until he is very sure of his ground. If he is not sure of his ground, he should beg for time and delay his decision. This is a perfectly permissible request. There is no hurry and it is time to act coolly and deliberately—although an inventor unaccustomed to modern business procedure is very apt to become flustered and excited. He has at last reached a point where the realization of reward for his idea appears to be within range, and it requires an impassionate man to cover up his feelings.

Providence indeed smiles when the price has been decided upon and nothing remains but the formal matter of signing an agreement for the manufacture of the article. Again dangerous ground is reached which the inventor under no circumstance should tread alone. He may think that he is very clever and that he understands law, but he will risk the danger of losing everything if he persists in his folly. If he does not have the money to hire a lawyer for the purpose of examining the contract he is called upon to sign, then he should borrow the money. It will not cost much and it may save everything. Few lawyers, in the event that negotiations have reached such a point with a responsible concern, will deny the inventor credit for a few weeks or months, and the opportunity should certainly be seized.

These warnings have been issued time and time again by men who have tried to extend a helping hand to men with inventions to sell, and time and time again they have been ignored. Not every manufacturer wants to steal an inventor's

idea; indeed, precious few would be guilty of such a thing; but the manufacturer wants to drive a tight bargain, and tight bargains can often be hidden in the most simple legal phraseology. A case in point recently came to the writer's attention when a western inventor appealed to him for help. This man had signed a contract covering the production of his idea. The company was small, though active, and entirely able to pay for any idea that it might use. It so happened, however, that the idea covered by the patent represented only a slight improvement over the device that the manufacturer was making, and that this improvement would have called for certain expenditures in the way of new equipment for manufacturing. The company did not want to make these expenditures unless forced to do so. Hence a contract perfectly worthless to the inventor was smartly drawn up in what appeared to be ordinary form. The inventor foolishly signed because he thought he understood it. Subsequent demands for accumulated royalty brought only evasive answers, until the poor fellow sought somebody's opinion. A reading of the contract at once made it evident that the concern had not promised to manufacture the article at all. There were no stipulations as to the number of articles to be produced each year, and no mention was made as to mimimum royalty in event the article was not produced at all. Yet the manufacturer in question accomplished two important things: he avoided expense and kept the idea out of the hands of his competitor. The inventor was left hog-tied and forlorn. Such are some of the tragedies of those who would improve the world.

In this as in other chapters of this volume, only generalities can be dealt in, and inasmuch as no inventor can encompass everything that might be of assistance to him, he is merely advised to seek the help of people who understand those things

that are beyond him. It is a simple matter, after all, and it will avoid every pitfall.

The foregoing matter has concerned the inventor who is in a position to call upon the likely buyer of his idea. Not every inventor is so fortunately situated. Many have to carry on their sales campaigns by correspondence; and while the same rules as to caution still hold, the limitation imposed upon such negotiations conducted by mail are a bit severe. More time is consumed, and on the whole the inventor must be a little more careful in the way in which he commits himself. He should bear in mind that he is putting things down in black and white, and that these black and white statements go into files where they are kept.

The same people are approached in much the same way. The seller of the invention merely tells the chief engineer or some other responsible officer of the company that he has such and such an idea for sale. It is suggested that *perhaps* the company might be interested. If a request comes for the patent papers or for a drawing of the idea, the inventor should send this material by registered mail with a return receipt requested from the local post office.

It is nice to be able to use fair English in such correspondence; it marks the inventor as a man of some cultural standing; and from this there is the inference, deserved or not, that the sender of the letters has some business sense. If at all possible, the letters should be neatly typed, even though it is necessary to engage the services of a public stenographer.

Under no circumstances should unsolicited ideas be submitted for attention. There should always be a letter asking for the privilege of submitting an idea. This is tactful and business-like, presuming nothing and requesting but a small favor which, nine times out of ten, will be gladly granted.

When the details of an invention are revealed in the weekly issue of the *Official Gazette,* the inventor will be sure to receive offers from questionable sources putting forth all sorts of schemes for selling inventions. Among other things, the inventor will perhaps receive a proposal that he subscribe $25 for an "engineering report," which is usually made up by some fifteen-dollar-a-week stenographer working in some dingy office.

The offers to establish a selling campaign on a "percentage basis" always involves the remittance of a certain sum "to defray the costs of correspondence, etc." This sum may be ten to twenty-five dollars and the resulting selling campaign may amount to precisely nothing so far as the interests of the inventor are concerned. It may be said without qualification that all of these offers should be avoided, no matter how sincere or plausible they may sound. Some schemes are worked on the plan of "no money down," but money will be asked for sooner or later.

Perhaps one of the rawest and vilest tricks that has ever been played on unsuspecting patentees is that in which the inventor is asked to sign a contract covering the sale of patent rights with what appears to be an honest organization. There is a guarantee of "no money down." The agents promise to meet every expense entailed by the effort to sell. This is such an apparently fair contract that the inventor unwittingly signs it, especially since it states very plainly that the inventor is not prevented from effecting a sale during the life of the contract.

When a really meritorious patent is covered by such a contract, a very dangerous situation is brought about. It is a foregone conclusion that the agents who have promised to be satisfied with nothing but their commission will do little toward

selling the idea beyond seeing to it that the contract is put in a place for safe-keeping. In the meantime the inventor may be approached by some responsible manufacturer who sincerely wishes to obtain the rights to the idea in question. Negotiations are innocently completed and the inventor writes to the agents informing them that the patent has been sold and asking them to desist in their effort to dispose of it. He is then immediately informed that the commissions mentioned in the contract are due and collectable. This is a disagreeable surprise, to say the least. Yet if the inventor reads his contract carefully, as he should have in the first place, he will note that the agreement stated that 25 percent was to be paid to the agents when the invention was sold. Nothing was said about *who* did the selling and the inventor innocently assumed that in this respect the contract referred to the agents. The plain truth of the matter is that it did not, and the inventor is bound by his signature to part with a very substantial part of the price that he received for his idea. Such is the price of experience.

There exists not only variations of this trick but other tricks as well, and no matter how sure an inventor may be of himself, he should refrain from signing any sort of an agreement that has not been examined by counsel. Most of the operators in this field are without scruples; their sole object is that of fleecing unsuspecting men whose meager contact with the business world has left them open to all sorts of questionable suggestions.

In the following pages the reader will find, word for word, a specimen contract which has actually been used and which anticipates practically every form of emergency that can arise during the manufacture of an invention under modern conditions. Not only does this contract protect the inventor, but it

protects the manufacturer as well. It is obvious that such agreements cannot be one-sided and that the inventor, as well as the manufacturer, will be called upon to make certain concessions.

Inasmuch as special conditions sometimes dictate the terms of such agreements, the reader cannot expect to insist upon this particular contract in his dealings. It is printed here merely to familiarize the student with the essentials to be covered. Variations in this coverage are bound to occur. The agreement follows:

### License Agreement

Memorandum of Agreement entered into this .. ..day of..... ..., 19 .. , by and between ... of ......... ..... .., party of the first part, hereinafter sometimes referred to as licensor, and . .. , of ..... , a corporation duly organized and existing under and by virtue of the laws of the State of . .. , party of the second part, hereinafter sometimes referred to as licensee, Witnesseth:

That whereas, the party of the first part is the inventor of a new and improved clamping device for which application for United States Letters Patent, Serial No. ..............., has been filed on ... ...., 19. , and

Whereas, the party of the second part is desirous of securing an exclusive license for the manufacture and sale of devices constructed in accordance with said invention;

Now therefore, for and in consideration of the sum of one dollar ($1), each to the other in hand paid and other goods and valuable considerations and the mutual performance of the undertakings herein, it is agreed by and between the parties hereto as follows:

1. The party of the first part hereby grants to the party of the second part the exclusive license to manufacture and sell devices constructed in accordance with the invention hereinabove identified throughout the United States for the term and upon the conditions

and subject to certain rights of cancellation, all as hereinafter set forth.

2. The term "United States" as used herein shall include not only continental United States, but also Alaska, the Hawaiian Islands, the Panama Canal Zone, the Philippine Islands, the Virgin Islands, and Porto Rico, namely, all territory which during the term of this agreement is subject to the jurisdiction of the United States, and either included in the patent grant, or to which the rights of United States Letters Patent may be extended by mere registration.

3. The term of this exclusive license shall extend throughout the term for which Letters Patent may be issued upon the aforesaid application unless sooner canceled.

4. The party of the second part will pay to the party of the first part a royalty for the manufacture or sale of the devices herein specified which shall amount to seven and one-half per cent (7½%) of the gross sales price at which said devices are sold.

For the purpose of this agreement, all devices shall be considered as sold when they have been billed out or if not billed out, when they have been delivered, shipped or mailed.

5. The party of the second part will immediately commence the production of the necessary tools and dies required in the manufacture of the devices which are the subject matter of this agreement, said tools and dies to be completed within ninety (90) days from date. Said tools and dies shall provide for the manufacture of . . . different sizes of clamps.

6. The party of the second part is hereby given the right at any time within ninety (90) days from date to cancel this agreement and be relieved from further responsibility thereunder.

7. Any improvements upon the invention which is the subject matter of this agreement that may be made by the party of the first part during the life of this agreement, shall come under the terms of this agreement and shall be available to the party of the second part without any additional royalty payments over and above the seven and one-half per cent (7½%) hereinbefore specified.

8. Any improvements made on devices which are the subject

matter of this agreement by or through the efforts of the party of the second part or acquired by it, or coming under its control, during the life of this agreement shall be the property of, and properly assigned to, the party of the first part to the full extent of the interest therein by the party of the second part.

9. The license herein granted shall after the year 19. cease to be exclusive, in the event that the royalties or amounts paid hereunder to the licensor shall for any calendar year fall below the sum of ....... ($ .. ). The party of the first part may thereupon grant other licenses under the invention aforesaid.

10. This license does not confer upon the party of the second part any right to grant sub-licenses.

11. The party of the second part will make the royalty payments provided for herein in quarterly periods, the respective quarters ending upon the first days of January, April, July, and October, and the payments for the preceding quarter are to be made on the tenth days of January, April, July, and October, respectively; on such days the party of the second part is also to furnish the party of the first part with certified statements of all of the sales relating to the devices which are the subject matter of this agreement made during the next preceding quarter.

12. The party of the first part is hereby given the right of access, through a certified public accountant, to those books of the party of the second part involved in these transactions, for the purpose of verifying said statements as to royalty payments, said access to be at reasonable business hours.

13. The party of the second part will properly affix the necessary statutory patent notices to all of the devices such as may be required according to the law and a refusal to fulfil the provisions of this paragraph gives the party of the first part the right to cancel this agreement on thirty (30) days' written notice, the cancellation to be effective at the end of the thirty (30) day period unless the party of the second part shall have cured the disability within that time.

14. The party of the second part shall manufacture the product made under this agreement so as to be first-class in every respect.

15. The party of the second part shall use its best endeavors to

market and sell to as wide an extent as its facilities permit the devices which are the subject matter of this agreement.

16. The party of the second part is hereby given the exclusive right during the time this agreement is in full force and effect, to sue infringers of the said patent or patents issued upon the application aforesaid, and the party of the first part in such cases will permit the use of his name in all such legitimate suits, sign all necessary papers, take all rightful oaths, and do whatever else may be necessary to assist the party of the second part in such suits, but at the expense of the party of the second part. Any recoveries from such litigation shall go to the party of the second part, with the proviso that should the recoveries exceed the outlays for said litigation, then the party of the first part shall receive his proportionate royalty from such excess. The party of the second part will during the time this agreement is in full force and effect diligently and promptly take those steps which are calculated to be in the best interests of the monopoly secured by the patent or patents which are the outgrowth of the patent application aforesaid and will, in the event of litigation, stand all of the charges, costs, and expenses of such litigation. The party of the second part will keep the party of the first part fully and promptly informed of such steps and of the progress of such litigation. The party of the first part may at his own expenses employ counsel who may act in an advisory capacity. Should the party of the second part fail, for any reasons of bad faith or inability, or with the intent to injure the said monopoly or interests of the party of the first part therein, to take the necessary steps and/or litigation as hereinbefore outlined, then the party of the first part may conduct in his own name and at his expense such litigation as he may deem necessary in the interests of said monopoly provided, that the party of the first part has first given a written ninety (90) days' notice to the party of the second part of his intention to initiate such litigation and provided further that the party of the second part fails during the said ninety (90) day period to initiate said suggested litigation. In the event, however, that the party of the first part must undertake such litigation, then the party of the first part has the right to cancel the exclusive feature of this license, and may thereupon license others under the

patent or patents which are the subject matter of this agreement.

17. In the event of the cancellation of this agreement or of its termination in any other manner, the party of the second part shall have the right to complete any and all contracts for the sale of the said devices that it may then have upon its books or that it has become obligated for any may work up and sell such uncomplete parts of the devices as it may have on hand at such expiration of this agreement, paying the same royalty as herein provided for, and provided such contracts and such sales shall be completed within six (6) months after such cancellation.

18. If by reason of strikes, fires or other similar disability, the party of the second part is temporarily prevented from carrying out the provisions of this agreement, then the cancellation clauses provided for herein shall not become operative until the said party of the second part has had a reasonable time to cure the disability, provided that such reasonable time shall in no event be more than three (3) months.

19. In the event that the party of the second part shall be sixty (60) days in arrears in the payment of royalties, then the party of the first part has the right to cancel this agreement, upon giving the party of the second part thirty (30) days' written notice, the cancellation of the agreement to be effective at the end of the thirty (30) day period unless the party of the second part shall have cured the disability within that time.

20. Should the devices which are the subject matter of this agreement when constructed in a workmanlike manner in accordance with the said invention, fail to perform their functions to the satisfaction of the normal purchaser or purchasers, then the party of the second part may cancel this agreement and be relieved from further liability thereunder by serving a sixty (60) days' written notice on the parties of the first part to this effect.

21. Should it be found within the period of one year from the date of this agreement, in the opinion of the party of the second part, impracticable for it to profitably market and sell the devices which are the subject matter of this agreement, then the party of the second part may cancel this agreement by giving the party of the first part a sixty (60) days' written notice to that effect.

22. The party of the second part hereby reserves the right to cancel this agreement and to be relieved from further obligations thereunder should the important claims in the patent or patents which ultimately issue upon the patent application aforesaid be declared invalid by a court of competent jurisdiction.

23. In case of receivership, bankruptcy, forced assignment or other financial difficulty by reason of which the party of the second part is prevented from carrying out the spirit of this agreement, then the rights hereunder shall revert to the party of the first part, at its election, upon thirty (30) days' written notice to the said party of the second part, which cancellation shall become effective at the end of the said thirty (30) day period unless the disability is cured within the said thirty (30) day period.

24. Should the party of the second part, after having once begun the successful manufacture of the devices, discontinue the active manufacture and sale of the devices for a period of three (3) months, then the party of the first part, at its election, may cancel this agreement upon sixty (60) days' written notice to the party of the second part, which cancellation shall become effective at the end of the said sixty (60) day period, unless the active manufacture and sale of the devices is recommenced within the sixty (60) day period.

25. The rights hereby conveyed by the said licensor to the said company are personal to the said company, and are not assignable by the said company without the consent of the said licensor, in writing.

26. The party of the second part will not manufacture and/or sell any devices competing with the devices specified in this agreement, during the continuance of this agreement.

27. The party of the second part will fill all bona fide orders sent to it by the party of the first part on the same terms as applied to the party of the second part's other customers; on all of such orders the party of the first part shall receive a commission of.... per cent (  %).

28. If at any time the party of the first part should waive its rights due to any breach of any of the provisions of this agreement, then such waiver is not to be construed as a continuing waiver of

other breaches of the same or other provisions of this agreement.

In Witness Whereof, the parties hereto have affixed their names and seals the day and year first above written.

*Party of the First Part.*

.....................

*Party of the Second Part.*

By .......... ..... ..

*President.*

.....................

*Secretary.*

# CHAPTER XIX

## PRICING INVENTIONS

IT quite often happens that inventors talk in millions when they should be talking in thousands. It seems almost a part of tradition that a patent must be worth at least a million dollars and that once Uncle Sam presents an inventor with an impressive document bearing the seal of the United States of America and carrying a blue ribbon, its proud possessor has a passport to immediate and fabulous wealth. He has but to set his price and the patent is snatched from him. Did not the inventor of the crimped hair-pin, the bottle top, the rubbered lead pencil, and the paper clip all receive great sums of money for their happy thoughts?

The pricing of an invention is not a very easy matter. Indeed, it is utterly beyond many men, and the best they appear able to do is to place some entirely arbitrary figure on their work. But the price asked for an invention must never be arbitrary; it must have ample justification based entirely upon the stark realities of the situation. There are certain limitations beyond which no sane purchaser will go; and most buyers are, to the inventor at least, disgustingly sane. They buy with the idea of profiting from their purchase. No profit, no sale.

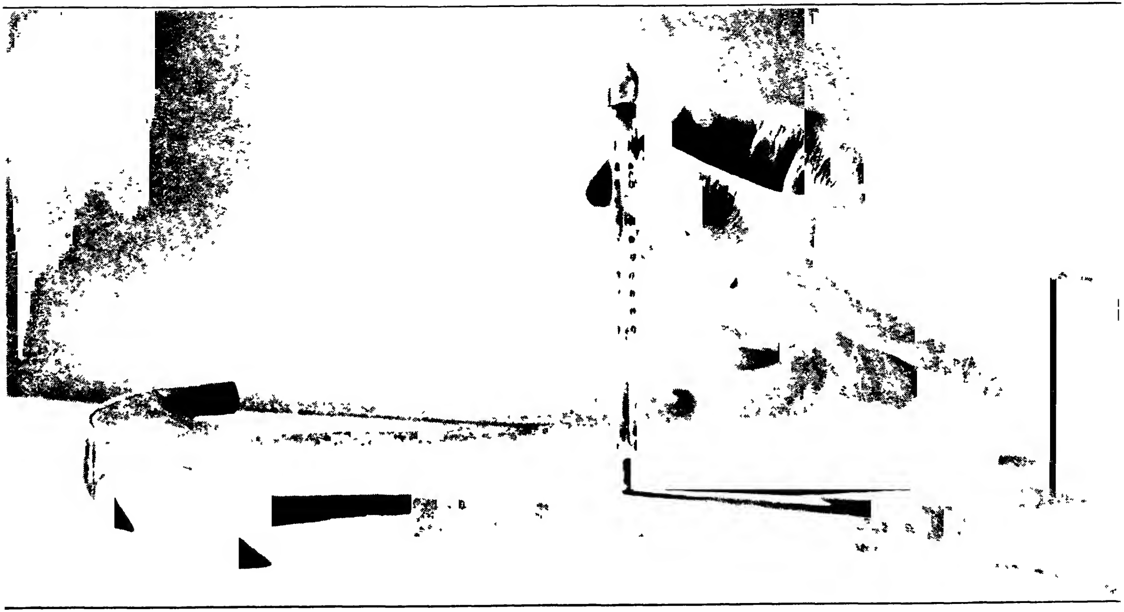
While the rules of pricing an invention are not hard and fast, they do, nevertheless, follow certain general lines. They must be based on reason, good sense, and the actualities of

the situation as far as it is possible to determine them. In nearly every case there will be found certain unpredictable factors that involve risk both on the part of the inventor, who does not want to make his price too low, and on the part of the purchaser, who does not want to make his price too high. This holds true particularly in connection with a device that is so new and so utterly revolutionary that no previous experience of public acceptance is available. After all, the public is fickle. It may or may not buy something that it needs, and at the same time it may rush to buy something that has, for some mysterious reason, become a fad although it is not really needed. Here the element of chance alone must be faced both by the inventor and the purchaser.

It sometimes occurs that substantial figures are available upon which it might be possible to determine a fair price. If an inventor had perfected a men's hose supporter, for instance, he might obtain figures showing the actual number of supporters sold each year. Such figures could be obtained from the Department of Commerce and might provide some sort of a more or less vague working basis.

It will be assumed that such an invention greatly adds to the convenience and efficiency of the article without increasing costs. This would argue very well for general public acceptance of the idea, but by no means would it prove that 100 percent coverage could be obtained. And there still would remain the problem of determining whether the idea should be sold or licensed to one manufacturer or licensed for the use of all. If the inventor is conducting his negotiations with the largest and most powerful unit in the field, he may decide that an outright sale would be the best basis upon which to place his requests.

The payment of royalty has advantages both for the inven-



TRANSFORMATION OF MECHANICAL ENERGY INTO HEAT

The mere pounding of a piece of iron with a hammer will raise the temperature of both the iron and the hammer This also holds true of all the other common metals, and it is conceivable that this simple principle will some day be applied in some sort of special thermostatic control

tor and for the manufacturer. If an invention meets with wide public acceptance and remains popular for a number of years, the inventor's reward will be many times what he might have received as an outright sale price. On the other hand, if the invention is not successful and the public does not buy it in large numbers, the manufacturer does not have a large royalty bill and he has not paid a huge sum for the idea. He may have paid the inventor several thousands of dollars to be charged against the first royalty check, but beyond that he is not involved save for the expense that was had in connection with preparation for manufacture and the advertising campaign.

In order that the inventor who attempts to calculate an outright sale price shall temper his figures with judgment, one of the common errors made in such calculations will be discussed. It might be found that 200,000 articles of the nature covered by the patent could be absorbed in one year. Such a figure would be based on previous experience in connection with the conventional articles already on the market, and might be obtained either from the Department of Commerce, Washington, D. C., or from some trade association. The inventor, basing his conclusions on this figure, naïvely convinces himself of the price to ask in the following manner: A royalty of 10 cents on each article sold could be asked, which would make a yearly payment of $20,000. The patent runs for a period of seventeen years. Therefore, the price asked will be 17 times $20,000, or $340,000.

Only an amateur would dare to ask such a price. It is far too large, and it is not based upon facts. First and foremost, the inventor quite loses sight of the fact that the manufacturer, who often works with money borrowed from a bank, is expected to earn at least 6 percent on his capital investment. Furthermore, it makes little difference whether or not the

money is borrowed. If it is in the treasury of the company 6 percent must be earned or at least should be earned, once the money is invested in a new venture. Thus the manufacturer must figure that this $340,000 investment will cost him $20,400 yearly or $346,800 over the period of seventeen years, even if the invention is not successful, which is among the possibilities no matter how rosy prospects might appear.

There is still another possibility that the inventor would not include in his figures and that is the fact that, due to the vast improvement that is going on in the world today, the average life of a new idea is closer to ten years than to seventeen. Then there is the constant danger that the device covered by the patent will be rendered obsolete before it reaches the market by the appearance of a still better article also covered by patent. When all of these factors are considered, a price amounting to perhaps one quarter of the sum originally asked would be quite sufficient—although it is difficult to propose accurate figures because of the special situations and problems that surround each invention and its market.

Above all, the inventor must learn to sympathize with the manufacturer and the conditions that he must meet. It is to be assumed that he will try to drive a tight bargain; but at the same time the inventor will gain if he will try to look at the manufacturer's risk and his responsibility to his stockholders. No matter how important the invention may be, its production in this day and age, when things are moving so rapidly, is a gamble, and the inventor is rightfully called upon not only to recognize this gamble but to assume part of the responsibility in facing it.

When royalties are paid, the inventor usually asks for a down payment when the contract is signed. This amount may be but a few hundred dollars or it may reach a figure of several

thousand, depending upon the importance of the invention. Such sums are charged against the first royalty check and are demanded to demonstrate good-will on the part of the manufacturer. For the inventor, such procedure assures him that the manufacturer means business.

The percentage of royalty to be asked depends largely upon the invention. It might amount to anything from 1 percent to 10 percent of earnings, or it might be based on so much for each article sold. At any rate, round figures are not often used, especially in connection with a small item that is intended for volume sale at a low price over the counters of the great American chain stores. Here the manufacturer is called upon to meet a very competitive price, and he always has to sharpen his pencil if he is to meet the demands of the shrewd chain-store buyers. In such cases the inventor might be called upon to accept a figure like .741 cent or 1.463 cents on each article sold. Thus does the manufacturer often have to split his pennies when he is dealing with this part of his trade. In some instances, he might sign a special contract with the inventor covering this outlet alone, with a higher royalty from articles bringing larger prices in the other channels of trade.

When the reader has completed this chapter he will have found no information concerning a direct formula that can be used in pricing. Nothing of the kind exists or can exist. The best the writer can hope to do is to provide the inventor with certain principles which must guide him in this work. When he reaches a point where he is actually faced with the problem of determining a price, he will do well to engage the assistance of someone connected with the industry to which his invention applies, preferably a business man acquainted with figures. If the inventor asks a certain figure for his idea, there must be something to back this figure.

Royalty can take on many different forms. It can be based on a percentage of the gross sale price of an article, on the net profit of an article, or on a certain percentage of the net profit earned by the invention over a specified period of time. If the inventor produces a machine that will manufacture a certain article more cheaply, he will want to tax or put a royalty on each item produced by the machine, whether it be matches or shoes. In other very special cases, where he has produced a much-needed piece of production machinery, he may license one manufacturer to build it and license a number of manufacturers to use it, the license being based on a healthy percentage of what that machine will save the people using it. Until recently most of the machinery used in canning factories was paid for in this way, a charge as high as $1,800 yearly being demanded for the use of equipment, the total value of which did not exceed this figure.

It is indeed unfortunate that so many inventors entirely at home in the actual work of inventing should be so much at sea when they are faced with the task of exploiting their ideas. Of course, one of the great drawbacks is that the inventor is very apt to approach this feature of his profession with misgivings and suspicion: he too often feels that the buyer will try to cheat him and to beat his figure down to a point where it will represent only a fraction of the amount that the invention is thought to be worth. While it is true that millions often shrink to thousands, this is so merely because the inventor placed too high a figure on his idea in the first place. This is the first great disillusionment which could be easily avoided if the feet were kept on the ground and the price based on a sane consideration of the actual factors involved.

# CHAPTER XX

## SELLING UNPATENTED INVENTIONS

IS there any hope for the unpatented invention? This is a question that always comes to the mind of the man who cannot afford the luxury of patent protection. Not a small number of men have commercially acceptable ideas with small means for exploiting them. Indeed, many excellent inventions have never come to the light of day but have remained in the minds of their inventors for actual need of the funds with which to build that legal fence about them that is so necessary in establishing them as the property of a certain individual.

There is, however, hope for the unpatented idea, and men placed in the unfortunate position of being unable to afford patents will be happy to learn that many unpatented ideas have been sold and will be sold in the future. It is inconceivable that a manufacturer would overlook an obvious opportunity to make money merely because an idea had not passed through the United States Patent Office. A certain well-established technique must be religiously followed, however, before such ideas can be safely offered for sale; a technique that not only provides the inventor with a fair degree of protection but protects the manufacturer as well.

In offering such ideas for sale, the inventor will do well to place himself in the position of the prospective buyer. The manufacturer is primarily interested in an item that will bring him greater profit; but at the same time he must guard against

lawsuits and infringement proceedings, which are always costly and bothersome. He cannot blindly rush into the manufacture, or even the mature consideration, of a new idea until he has had certain assurances that the inventor must provide. The first assurance must be that of proving as far as possible that the proposed idea is new. Very definite proof must be offered concerning this point, and even the best proof offers certain limitations which cannot be overcome with the method employed. Too much emphasis cannot be placed on this point.

Inventors who wish to dispose of unpatented inventions will do well to avoid sending ideas "in the raw" to manufacturers. It is unfair to the manufacturer and a waste of time for the inventor. Before any unpatented idea is submitted to a manufacturer, the inventor should institute a search in the United States Patent Office, and this search should be of a very thorough nature. A mere preliminary search will not do. It leaves too many unexhausted possibilities. Furthermore, the searching much be done by a competent person, and when he has finished with the search he must supply the inventor with a properly executed affidavit to the effect that the United States Patent Office has been thoroughly searched and that it is his opinion that no damaging references have been found. This affidavit, together with drawings of the invention and all of the references found, must be sent to the manufacturer under registered mail with a return receipt requested from the post office. Thus possible confusion is avoided and the inventor has proof that the manufacturer received the idea. On the other hand, the manufacturer has reasonable assurances that the idea submitted for his consideration is new. Absolute assurance cannot be established, for the simple reason that part of the reference file of the United States Patent Office remains secret. This is the file of new and pending applications which, by the very

nature of things, cannot be made available except to the trusted employees of the Office. Anywhere from 5,000 to 30,000 cases may be on file, and this is the hazard that will always remain over the head of unpatented ideas. However, it is a hazard that most manufacturers will overlook in considering good ideas for possible production. After all, even some patents have been invalidated after they have issued merely because the idea was found old. Neither our Patent Office nor any patent office in the world is utterly infallible.

Of course, it is assumed that the inventor will also protect himself before he submits his idea for approval. This protection is the same as that outlined in Chapter III. Such simple procedure provides two years of legal recognition in the establishment of the right of ownership.

If the manufacturer turns the idea down, the inventor has no recourse save that of bringing the idea to the attention of the next largest producing unit in the industry to which his invention applies. In case the manufacturer accepts the idea, he will, if he is wise, accept it on a tentative basis and only with a signed agreement with the inventor. In this agreement the manufacturer will probably offer to pay patent expenses, and he will either ask the inventor to assign the patent to him or to give him an exclusive license under the patent. Naturally, the agreement will become valid only as, if, and when the patent actually issues from the Patent Office. If it is rejected by the Patent Office examiners, all of the time and effort will have been lost but, after all, that is the chance that any inventor takes whether or not he is attempting to exploit an unpatented idea.

Some of the smaller manufacturers will ask the inventor to agree to the payment of the patent fees from the first royalties received. There is really no hard and fast rule that can be

applied in such cases. It is barely possible that the inventor will be asked to assume this responsibility before any royalty has been earned. When matters develop in this way, however, the inventor has something more definite to work with; he has established the interest of a responsible producer in his idea, and this will provide a foundation on which he can gain financial assistance, either on an outright loan basis or with the stipulation that a small percentage of the money earned by the patent, if and when it issues, will go to the party making the loan.

The market for new inventions of worth is wide and highly competitive, and the mere absence of patent protection is not a hopeless obstacle provided the procedure outlined above is faithfully followed out. After all, no manufacturer is going to overlook the possibility of large profit by balking at the prospect of patent costs. Every possible guarantee that the idea is new must, however, be established before this form of coöperation can be expected. It is well not to lose sight of the fact that all of our large corporations receive many unsolicited and unpatented ideas, and cannot be expected to make their own investigations and their own searches of the Patent Office in each instance. Such activity would run into fabulous sums each year, and the least that the inventor can do, as a courteous gesture if nothing else, is to submit his idea in as complete a form as possible.

Not every inventor who cannot afford patent protection is bold or trusting enough to follow the procedure outlined above. By many it is regarded as very dangerous. Of course, it must be admitted that this method is not as safe as the more legally acceptable idea of having a patent issue; but the element of risk is not nearly as high as most inventors believe, especially when reputable manufacturers of high standing are ap-

proached. These concerns do not need to steal ideas and, as a matter of proven fact, they do not steal ideas. Fifty years ago there was a certain amount of invention piracy current but it is rare today. It would appear that the sympathy of courts has moved closer to the struggling inventor and that manufacturers on the whole are far more altruistic than they were in the "old days." Furthermore, the competition for new material is so keen today that no manufacturer has a desire to injure his reputation for fair dealing.

Even with conditions as they are, we still hear the whine of the man who claims that he was cheated out of his invention. In most cases it is the inventor who is at fault, for the simple reason that his knowledge of the legal complications of the situation are such that he cannot form a fair opinion. It goes without saying that no manufacturer, no matter how altruistic, is going to pay a million dollars for an idea which can be had by due and honest legal procedure for nothing or next to nothing. A man may submit what he thinks is a new idea to a manufacturer only to have it courteously rejected. If something akin to this invention is eventually marketed by this manufacturer, the inventor rushes to the conclusion that his idea was appropriated. Such would not necessarily be the case. The manufacturer might have a perfect right to this invention, either by his having worked on the idea before the inventor's offer arrived, or by having conducted negotiations with another inventor of the same idea at an earlier date. In any case, the disgruntled complainant still has the opportunity of appealing to the courts or of proving to the Patent Office that he is the true originator of the invention.

# CHAPTER XXI

## HOW AN INVENTOR MAY TAKE OUT HIS OWN PATENT

THE patent laws of the United States make it possible for every inventor to prosecute his own case by mail. Contrary to the general impression, it is not necessary to engage a professional patent attorney for this purpose; and many inventors, through a careful study of the patent system and the procedure in taking out patents, have been able to prosecute their own cases with greater efficiency than the average attorney could provide. No patent attorney, no matter how capable or conscientious, can take an interest in an invention as great as that of the inventor himself.

The writer does not urge the student to act as his own patent attorney, but merely wishes to point out the possibility of doing this in cases where there is a lack of funds or where the inventor feels that he can do better by handling his own case. If an inventor does handle his own case, a patent may be obtained for as little as $60. This charge is made up of the initial government fee of $30 and the final government fee of $30 when the patent is issued. In ordinary cases it is necessary only that an inventor should be able to write correct English and know the details of the procedure required at the Patent Office.

After the idea is perfected, the first step in obtaining a patent is the preparation of what is known as the petition. The petition is really a request made to the Commissioner of

Patents that he grant a patent on the idea developed by the inventor. This simple document takes a standard form and is signed by the inventor without witnesses. (At this point the writer wishes to warn the student that the name signed to all the patent papers should agree. It is best to sign the name in full each time.)

The following is a standard form of the petition. This must be typewritten or printed and should never be written off in pen and ink.

### Petition

To the Commissioner of Patents:

Your petitioner.... .................a citizen of .....
*(name of applicant)* *(country)*
............and a resident of..... ........ in the County
*(city)*
of.................... and State of..............., whose post office is ......................prays that letters patent may be granted to him for the improvement in . . ..
*(name of invention)*
....... set forth in the annexed specification.

Signed at........... ..... in the County of ...........
*(city)*
and State of..............., this ...........day of........
193.

*(Full name of applicant)*

Accompanying the petition there should be an oath which is also typewritten and signed by the applicant for the patent. Both the inventor's signature and the title of the invention

must correspond exactly with those mentioned in the petition. The petition, the oath, and the patent specifications should be carefully fastened together and carried to a notary public, who will attach his signature and seal to the oath. It is absolutely necessary to have the oath sworn to before a notary.

It is also necessary to prepare the patent specifications with the greatest care. Only the best English is used, and if the inventor is not sure of himself in this respect, he should have a friend look over his specifications to see that the terms are properly employed, the sentences properly constructed, and the punctuation placed correctly. The specifications submitted by the inventor to the Patent Office are always printed just as they are, providing they are correct and acceptable to the patent office examiner. If the examiner objects to their punctuation, or statement of facts, the specifications will be immediately returned with instructions for their correction. In fact, it happens rarely that patent specifications get through in their original state.

The patent specifications should always begin under the title of the invention. The first paragraph, more or less standard, follows:

To All Whom It May Concern:

Be it known that.............................a citizen
(*name of inventor*)

of.................., residing in.................., in the
(*country*) (*city*)

County of.................and State of............., has

invented a new and useful........................., of which
(*title of invention*)

the following is a specification.

In the second paragraph of the specifications the inventor must describe the general nature of the new device and call attention to the service for which it is intended. In another paragraph the inventor very briefly describes the patent drawing that is submitted with the specifications. The succeeding paragraphs describe the invention in detail, with constant references to the drawing or drawings so as to make the construction and operation of the new device clear to the Patent Office examiners and to those who may care to read the patent after it has issued.

After this exposition, the claims are prepared. It is necessary to number each claim, and each claim is made up of but a single sentence, which stands by itself as an independent paragraph. There is no limit set on the number of claims, but attorneys agree that the strength of a patent can in no way be gauged by the number of claims. In fact, it is generally believed that the fewer claims the better, and some of the strongest patents have had but very few claims. The wording of the claims should be done with the greatest care. In the case of a very simple instrument or invention, it may be found possible to use but a single claim.

After the claims are prepared, the specifications are ended with this paragraph:

In testimony whereof I affix my signature in the presence of two witnesses.

(*Full signature of inventor*)

. . . . . . . . . . . . . . . . . . .

(*Witness*)

. . . . . . . . . . . . . . . . . . . . .

(*Witness*)

part of the invention, and the function of this part is outlined in the specification in the following manner:

In the accompanying, forming a part hereof, Figure 1 is an elevation of my improved jack structure showing its lifting chamber in collapsed condition; Fig. 2, a view partially in section taken on the dotted line 2, 2, in Fig. 1, and showing the lifting chamber inflated; Fig. 3, a plan on the dotted line 3, 3, in Fig. 1; Fig. 4, a horizontal sectional view looking in the direction of the arrows 4, 4, in Fig. 2; and Fig. 5 is an elevation showing the lifting chamber in modified form.

In said drawing the base of my improved jack is indicated by the numeral, 5, to which base is secured a frame, 6, which may comprise a single or plurality of preferably arched standards, 7. Where I employ a single frame member, the same is provided with a central opening, but where a greater number are used, I prefer to turn up the ends, 8, thereof and secure there between a sleeve, 9, in which opening or sleeve, as the case may be, I mount a vertical adjustable lifting member or jack, 10, provided at its upper end with a seat, 11, and having at its lower end a base, 12.

The inventor places his name within the rectangle at the lower right-hand corner of the drawing, and the names of the witnesses are placed in the opposite corner.

The examiners at the Patent Office are very, very particular about the neatness of the drawing, and it is imperative that all drawings be made with drafting instruments. If the inventor feels that he cannot make a drawing that will pass the examiner at the Patent Office, he should enlist the services of some local draftsman, who will be glad to make it for him for a small charge.

With the petition, the oath, the specifications, and the patent drawing completed, they should be carefully placed together and mailed with a fee of thirty dollars to the Commissioner of Patents, Washington, D. C. The drawing should not be

folded, and it is advisable to mail it flat with a good strong backing that will prevent it from being damaged in transit. Drawings will be rejected by the examiners if they are damaged.

When the complete application reaches the Patent Office, it will immediately be classified and given a serial number, and the inventor will at once be notified of this procedure. After this, the patent must await its turn before it is given the attention of the Patent Office examiners. It is the duty of the examiner to consider carefully the patent claims and to search the Patent Office to see that a similar device has not been patented before. In other words, he investigates the art to which the particular patent under consideration applies. Before this, however, he will carefully examine the drawings, the wordings of the specifications, and the general details. If he finds any mistakes, he will communicate with the inventor and the necessary corrections will have to be made.

The Patent Office examiner at once searches the Patent Office files under the particular classification to which the invention applies, and if he finds claims in other patents that anticipate anything in the patent under consideration, the claims of the latter patent will be rejected unless the inventor can show good reasons why they should not be. In some cases it may be found that practically every feature of a patent has been anticipated in other patents; and this, of course, makes it impossible to grant a patent. The Patent Office examiner also cites references that he finds in other patents, and this data is brought to the attention of the inventor. In some cases it may be found that practically all the claims of a patent will be disputed, and the inventor may find it necessary to withdraw his application.

The writer wishes to warn the student to carry on the most

courteous and business-like correspondence with the examiner. Abusive language will not help any situation. The examiners are not anxious to find references that will interfere with the claims of a patent, and it is only through their watchfulness in this respect that later litigation is prevented.

In case the examiner rejects a certain claim, the inventor can request its retention.

Amendments to a patent can be made under certain conditions. If an inventor forgets a certain important detail until after his claim is filed, he may make a request for an amendment in the following way:

AMENDMENT

To the Commissioner of Patents:

In the matter of my application for a letters patent for an improved . ..............., filed .. 19 .,
serial number .................., I hereby amend as follows:
.....................................................
.....................................................
. ....................................................
Signed at .................. County of .................
State of................ ... . ...
Signature

An applicant for a patent may present new amendments as often as the examiner presents new references in the dispute of a claim or claims. If the examiner finally rejects a claim which the inventor feels should be allowed, the argument may be carried to the Examiner-in-Chief by paying an additional fee. Rejections in this case need not be final, and by the payment of further fees the applicant is able to carry his case before the Commissioner of Patents.

After the inventor and the Patent Office examiners come to

an agreement over the allowance of claims, a notice of allowance of the patent is issued. The notice is a printed one and this notice calls for the final payment of thirty dollars within six months' time.

It might be stated here that the time necessary for the allowance of a patent varies. If the particular department in which the patent must be examined is busy, as much time as a year may be necessary for the examiners to act. In other cases it is possible that only four months will be necessary.

Within three months after the patent claims are granted and the final fee is paid, the patent is published and a copy mailed to the inventor, granting to him for a period of seventeen years the right to make, use, and sell the invention within the United States of America.

## CHAPTER XXII

### A LIST OF NEEDED INVENTIONS

TO help the inexperienced inventor to hold his inventive efforts within practical lines, and to help him recognize actual human need, a list of needed inventions is supplied herewith. While it is true that patents have been issued in connection with many of these ideas, the mere fact that such a patent exists does not mean that the article covered by it is practical or commercially feasible. A patent guarantees nothing; and, for that matter, practically everything in the mechanical world must some day be invented all over again. That is what we call progress. Merely because a patent issues covering a new pistol, it does not follow that all of the inventors working on improvements along this line will scrap their ideas.

The object of presenting this list is twofold: to help the inventor recognize the kind of things the public needs, and to supply him with actual problems upon which he can exercise his ingenuity. The list follows:

1. A tooth-paste tube with a self-sealing orifice that will eliminate the present cap and yet keep the tube closed.
2. A simple ten-cent device that will permit ladies to mend the runs in silk stockings.
3. China cups with handles that will not break off.
4. An attachment for a bench vise that will permit oddly shaped objects to be firmly held.
5. A hack-saw that will extend in two directions so that deeper cuts may be taken.

6. An adjustable baking tin that can be used for cakes of various sizes.
7. A padless rubber stamp that will not need ink.
8. A carpenter's plane that will not clog.
9. A ventilated light socket that will radiate surplus heat from high-wattage lamps.
10. A method of preventing flat spots on trolley wheels.
11. A means of holding up socks without interfering with the circulation of blood in the legs.
12. An automatic toaster that will also butter the toast before it ejects it.
13. A cheap timer for hot-water heaters that will turn the gas off at pre-determined periods.
14. An electrical receptacle that may be put into a plug at any point of the circle.
15. Earrings that will not pinch or drop off.
16. A camera supporter or tripod with a single leg and great portability.
17. An explosion-proof automobile muffler.
18. A cheap dropper for the tops of patent medicine bottles.
19. An electric bottle warmer for babies that will automatically cut the current off when the bottle has reached the proper temperature.
20. A method of preventing sole rubbers from slipping at the heel.
21. A fountain pen that will register the amount of ink it contains without being transparent.
22. A lawn mower that will not clog with bits of wood and stones.
23. A practical muffler for airplane engines.
24. A simple and cheap tool for the removal of fruit-jar tops without danger of breakage.
25. An inexpensive vegetable slicer for kitchen use made of pressed metal.
26. Anti-glare rear-view mirror for automobiles.
27. Penny-in-the-slot scales that will automatically give the height of the person being weighed.
28. Improved method of fastening door knobs to shafts.

29. A device that ladies may carry in their pocket-books to remove spots from white shoes.
30. A hand-operated egg beater that can be easily washed.
31. A sprinkler that will automatically creep over the lawn.
32. A machine to wash, dry, and disinfect towels in public places.
33. A self-wiping safety-razor-blade holder that will not have to be taken apart for drying.
34. An automatic magazine hammer for brads and tacks.
35. A shock-proof cake pan.
36. A camera with which it is impossible to make double exposures.
37. A skid-proof motorcycle.
38. A sod-cutting tool.
39. A window screen that can be adjusted in two dimensions.
40. A blotting device for fountain pens.
41. Sanitary toothpick dispenser for restaurants.
42. A stopper for ink bottles that can be sold separately and that will automatically close when the pen has been removed.
43. A method of picking up air-mail sacks by airplanes traveling at high speed.
44. A simple device to cut a new nap on the shiny seats of trousers.
45. A method of making candles burn with colored flames through the admixture of the proper chemicals.
46. A non-leaking bathing cap.
47. An attachment for taking panoramic pictures with an ordinary kodak.
48. An odorless ash tray.
49. A drill or auger that will produce square holes.
50. An automobile-trailer coupling that will not break.
51. A lock for outdoor use that will never rust or corrode.
52. A simple method of preventing rugs from slipping on waxed floors.
53. Non-clogging furnace grates.
54. An electric coffee percolator that can be submerged in water for washing.

55. A device to sharpen drills in machine-shops without removing them from the chucks.
56. An electrically operated device to remove the ice and sleet from the sidewalks in front of stores.
57. A sanitary soap holder that will gently grip the soap and permit it to drain.
58. A wood plane with a calibrated dial that will indicate the depth of the cut about to be made.
59. An electrically driven shoe brush.
60. A necklace clasp that will not become unfastened accidentally.
61. A pressed metal mitre box that can be sold for one dollar.
62. An automobile-tire valve that will indicate air pressure.
63. A little ten-cent article with which the house-wife may quickly skim the grease off cooking soup.
64. A captive golf ball that will tell how far the ball would have gone had it been free.
65. A device that will help mothers mount curb stones with baby carriages.
66. A window-puttying tool that will feed the putty in a triangular strip.
67. A dog muzzle that will prevent a dog from barking without hurting him.
68. A simple article that will keep the shoulder-straps of ladies' undergarments in place.
69. A simple little kitchen device that will shell peas quickly.
70. A self-watering flower-pot equipped with a reservoir.
71. A method of preventing trousers from bagging at the knees.
72. A beer-bottle or pop-bottle cap that can be removed with the fingers.
73. Means of preventing scalding water from shower-bath sprays.
74. A wind-proof awning.
75. A fire-hose nozzle that can be safely handled by one man.
76. A simple article to peel hard-boiled eggs.
77. A waffle-iron that will not overflow.

# APPENDIX

## RULES OF PRACTICE IN THE UNITED STATES PATENT OFFICE

August 1, 1933

### Correspondence and Interviews

*Business to Be Transacted in Writing*

1. All business with the office should be transacted in writing. Unless by the consent of all parties, the action of the office will be based exclusively on the written record. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is a disagreement or doubt.

*Correspondence to Be in the Name of the Commissioner*

2. All office letters must be sent in the name of the "Commissioner of Patents." All letters and other communications intended for the office must be addressed to him; if addressed to any of the other officers, they will ordinarily be returned.

*All Charges to Be Prepaid*

3. Express charges, freight, postage, and all other charges on matter sent to the Patent Office must be prepaid in full; otherwise it will not be received.

*Personal Attendance of Applicants Unnecessary*

4. The personal attendance of applicants at the Patent Office is unnecessary. Their business can be transacted by correspondence.

*Correspondence with Assignees*

5. The assignee of the entire interest of an invention is entitled to hold correspondence with the office to the exclusion of the inventor. (See rule 20.)

### *Correspondence with Inventor and Assignee*

6. When there has been an assignment of an undivided part of an invention, amendments and other actions requiring the signature of the inventor must also receive the written assent of the assignee; but official letters will only be sent to the post-office address of the inventor, unless he shall otherwise direct.

### *Correspondence with Attorney*

7. When an attorney shall have filed his power of attorney, duly executed, the correspondence will be held with him.

A double correspondence with the inventor and an assignee, or with a principal and his attorney, or with two attorneys, can not generally be allowed.

### *Separate Letters*

8. A separate letter should in every case be written in relation to each distinct subject of inquiry or application. Assignments for record, final fees, and orders for copies or abstracts must be sent to the office in separate letters.

Papers sent in violation of this rule will be returned.

### *Letters Relating to Applications*

9. When a letter concerns an application, it should state the name of the applicant, the title of the invention, the serial number of the application (see rule 31), and the date of filing the same (see rule 32).

### *Letters Relating to Patents*

10. When the letter concerns a patent, it should state the name of the patentee, the title of the invention, and the number and date of the patent.

### *Protests*

11. No attention will be paid to unverified *ex parte* statements or protests of persons concerning pending applications to which they are not parties, unless information of the pendency of these applications shall have been voluntarily communicated by the applicants.

### *Public-Use Proceedings*

When a petition for the institution of public-use proceedings, supported by affidavits, is found, on reference to the primary examiner, to

make a *prima facie* showing that the invention involved in an interference or disclosed in an application believed to be on file had been in public use or on sale two years before the filing of the application, or before the date alleged by an interfering party in his preliminary statement, a hearing may be had before the commissioner to determine whether a public-use proceeding should be instituted. If instituted, times may be set for taking testimony.

The papers should be filed in duplicate, or served upon the applicant or his attorney of record and petitioner should offer to bear any expense to which the office may be put.

*Mail*

12. Mail placed in the Patent Office pouch in the post office at Washington, D. C., up to 4.30 p. m. on week days, excepting holidays, and 1 p. m. on half holidays, is entered as received in the Patent Office on the day it reaches the post office.

*Filing of Papers after Office Hours*

Special-delivery letters and other papers may be deposited in a box provided at the watchman's desk at the E Street entrance of the Patent Office up to midnight on week days, including holidays, and all papers deposited therein are entered as received in the Patent Office on the day of deposit.

*Answers to Letters and Telegrams*

Letters received at the office will be answered, and orders for printed copies filled, without unnecessary delay. Telegrams, if not received before 3 o'clock p. m., can not ordinarily be answered until the following day.

*Interviews with Examiners*

13. Interviews with examiners concerning applications and other matters pending before the office must be had in the examiners' rooms at such times, within office hours, as the respective examiners may designate; in the absence of the primary examiners, with the assistant in charge. Interviews will not be permitted at any other time or place without the written authority of the Commissioner. Interviews for the discussion of pending applications will not be had prior to the first official action thereon.

## Information to Correspondents

### *Subjects on Which Information Can not Be Given*

14. The office can not respond to inquiries as to the novelty of an alleged invention in advance of the filing of an application for a patent, nor to inquiries propounded with a view to ascertaining whether any alleged improvements have been patented, and, if so, to whom; nor can it act as an expounder of the patent law, nor as counsellor for individuals, except as to questions arising within the office.

### *Records and Models Open to Inventors*

Of the propriety of making an application for a patent, the inventor must judge for himself. The office is open to him, and its records pertaining to all patents granted may be inspected either by himself or by any attorney or expert he may call to his aid, and its reports are widely distributed. (See rule 196.) Further than this the office can render him no assistance until his case comes regularly before it in the manner prescribed by law. A copy of the rules, or circular of information, with a section marked, sent to the individual making an inquiry of the character referred to, is intended as a respectful answer by the office.

Examiners' digests are not open to public inspection.

### *Pending Applications Kept in Secrecy*

15. Pending applications are preserved in secrecy. No information will be given, without authority, respecting the filing by any particular person of an application for a patent or for the reissue of a patent, the pendency of any particular case before the office, or the subject matter of any particular application, unless it shall be necessary to the proper conduct of business before the office, as provided by rules 91, 97, 103, and 108.

### *Records and Copies in Patented Cases*

16. After a patent has issued, the model, specification, drawings, and all documents relating to the case are subject to general inspection, and copies, except of the model, will be furnished at the rates specified in rule 191.

## Attorneys

### *Attorneys*

17. An applicant or an assignee of the entire interest may prosecute his own case, but he is advised, unless familiar with such matters, to

employ a competent patent attorney, as the value of patents depends largely upon the skillful preparation of the specification and claims. The office can not aid in the selection of an attorney.

A register of attorneys will be kept in this office, on which will be entered the names of all persons entitled to represent applicants before the Patent Office in the presentation and prosecution of applications for patent. The names of persons in the following classes will, upon their written request, be entered upon this register:

*Lawyers*

(*a*) Any attorney at law who is in good standing in any court of record in the United States or any of the States or Territories thereof and who shall furnish a certificate of the clerk of such United States, State, or Territorial court, duly authenticated under the seal of the court, that he is an attorney in good standing, and who shall file proof that he is possessed of the legal and technical qualifications enumerated in paragraph (*b*).

(*b*) Any person not an attorney at law who is a citizen or resident of the United States who has had 3 years' experience in patent work under the personal direction and supervision of a duly registered patent attorney, or who has served for 3 years in the examining corps of the Patent Office, and who shall file proof to the satisfaction of the Commissioner that he is of good moral character and of good repute and possessed of the necessary legal and technical qualifications to enable him to render applicants for patents valuable service and is otherwise competent to advise and assist them in the presentation and prosecution of their applications before the Patent Office.

*Foreign Attorneys*

(*c*) Any foreign patent attorney not a resident of the United States, who shall file proof to the satisfaction of the Commissioner that he is registered and in good standing before the patent office of the country of which he is a citizen or subject, and is possessed of the qualifications stated in paragraph (*b*): *Provided,* That the patent office of the country of which he is a citizen or subject allows substantially reciprocal privileges to those admitted to practice before the United States Patent Office.

*Firms*

(*d*) Any firm will be registered which shall show that the individual

members composing the firm are each and all registered under the provisions of the preceding sections.

(*e*) The Commissioner may require proof of qualifications other than those specified in paragraph (*a*) and reserves the right to decline to recognize any attorney, agent, or other person applying for registration under this rule.

(*f*) Any person or firm not registered and not entitled to be recognized under this rule as an attorney or agent to represent applicants generally may, upon a showing of circumstances which render it necessary or justifiable, be recognized by the Commissioner to prosecute as attorney or agent certain specified application or applications, but this limited recognition shall not extend further than the application or applications named.

(*g*) No person not registered or entitled to recognition as above provided will be permitted to prosecute applications before the Patent Office.

### *Advertising*

(*h*) Every attorney registered to practice before the United States Patent Office shall submit to the Commissioner of Patents for approval copies of all proposed advertising matter, circulars, letters, cards, etc., intended to solicit patent business, and if it be not disapproved by him and the attorney so notified within 10 days after submission, it may be considered approved.

Any registered attorney sending out or using any such matter, a copy of which has not been submitted to the Commissioner of Patents in accordance with this rule, or which has been disapproved by the Commissioner of Patents, shall be subject to suspension or disbarment.

### *Registration Fee*

Before his name may be entered on the Register of Attorneys every applicant must subscribe and swear to an oath prescribed by the Commissioner of Patents and pay to the Patent Office a registration fee of $5.

### *Power of Attorney*

18. Before any attorney, original or associate, will be allowed to inspect papers or take action of any kind, his power of attorney must be filed. But general powers given by a principal to an associate can not be considered. In each application the written authorization must be filed. A power of attorney purporting to have been given to a firm or copart-

nership will not be recognized, either in favor of the firm or of any of its members, unless all its members be named in such power of attorney.

*Substitution and Association*

19. Substitution or association can be made by an attorney upon the written authorization of his principal; but such authorization will not empower the second agent to appoint a third.

*Revocation*

20. Powers of attorney may be revoked at any stage in the proceedings of a case upon application to and approval by the Commissioner; and when so revoked the office will communicate directly with the applicant, or another attorney appointed by him. An attorney will be promptly notified by the docket clerk of the revocation of his power of attorney. An assignment will not operate as a revocation of the power previously given, but the assignee of the entire interest may be represented by an attorney of his own selection.

*Attorneys' Room—Personal Interviews with Examiners*

21. Parties or their attorneys will be permitted to examine their cases in the attorneys' room, but not in the rooms of the examiners. Personal interviews with examiners will be permitted only as hereinbefore provided. (See rule 13.)

*Decorum and Courtesy in Business—Papers Returned*

22. (*a*) Applicants and attorneys will be required to conduct their business with the office with decorum and courtesy. Papers presented in violation of this requirement will be submitted to the Commissioner and returned by his direct order.

*Complaints against Examiners*

(*b*) Complaints against examiners and other officers must be made in communications separate from other papers and will be promptly investigated.

*Refusal to Recognize Agents*

(*c*) The Commissioner of Patents may, after notice and opportunity for a hearing, suspend or exclude, either generally or in any particular case, from further practice before his office any person, agent, or attorney shown to be incompetent or disreputable, or guilty of gross mis-

conduct, or who refuses to comply with the rules and regulations, or who shall, with intent to defraud in any manner, deceive, mislead, or threaten any applicant or prospective applicant, or other person having immediate or prospective business before the office, by word, circular, letter, of by advertising, or who shall guarantee the successful prosecution of any application for patent or the procurement of any patent, or by word, circular, letter, or advertisement shall make any false promise or misleading representation, or who uses the name of any Member of either House of Congress or of any officer of the Government in advertising his business. (Act approved April 27, 1916.) The reasons for any such suspension or exclusion shall be duly recorded. And the action of the Commissioner may be reviewed upon the petition of the person so refused recognition or so suspended or excluded by the Supreme Court of the District of Columbia under such conditions and up... such proceedings as the said court may by its rules determine.

*Grievance Committee*

(*d*) The Commissioner of Patents may appoint a Grievance Committee or Grievance Committees of those admitted to practice before the Patent Office. The Commissioner may refer to such committee such complaints against those admitted to practice before the Patent Office as he deems advisable. The committee or a subcommittee thereof may investigate and determine whether the complaint is well founded and, if so, present charges for suspension or exclusion from practice.

*Services of Senators or Representatives*

23. Inasmuch as applications can not be examined out of their regular order except in accordance with the provisions of rule 63, and Members of Congress can neither examine nor act in patent cases without written powers of attorney, applicants are advised not to impose upon Senators or Representatives labor which will consume their time without any advantageous results.

APPLICANTS

24. A patent may be obtained by any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement thereof, or who has invented or discovered and asexually reproduced any distinct and new variety of plant, other than a tuber-propagated plant, not known or used by others in this country before his invention or discovery thereof, and not patented or described in any printed publication in this or any

foreign country before his invention or discovery thereof, or more than two years prior to his application, and not patented in a country foreign to the United States on an application filed by him or his legal representatives or assigns more than twelve months before his application, and not in public use or on sale in the United States for more than two years prior to his application, unless the same is proved to have been abandoned, upon payment of the fees required by law and other due proceedings had. (For designs, see rule 79.)

### *Executors and Administrators*

25. In case of the death of the inventor, the application will be made by and the patent will issue to his executor or administrator. In that case the oath required by rule 46 will be made by the executor or administrator. In case of the death of the inventor during the time intervening between the filing of his application and the granting of a patent thereon, the letters patent will issue to the executor or administrator upon proper intervention by him. The executor or administrator duly authorized under the law of any foreign country to administer upon the estate of the deceased inventor shall, in case the said inventor was not domiciled in the United States at the time of his death, have the right to apply for and obtain the patent. The authority of such foreign executor or administrator shall be proved by certificate of a diplomatic or consular officer of the United States.

### *Insane Person*

In case an inventor become insane, the application may be made by and the patent issued to his legally appointed guardian, conservator, or representative, who will make the oath required by rule 46.

### *Patents to Assignees—To Inventors and Assignees Jointly*

26. In case of an assignment of the whole interest in the invention, or of the whole interest in the patent to be granted, the patent will issue to the assignee; and if the assignee hold an undivided part interest, the patent will issue jointly to the inventor and the assignee; but the assignment in either case must first have been entered of record, and at a day not later than the date of the payment of the final fee (see rule 188); and if it be dated subsequently to the execution of the application, it must give the date of execution of the application, or the date of filing, or the serial number, so that there can be no mistake as to the particular invention intended. The application and oath must be signed by the actual inventor, if alive, even if the patent is to issue to an assignee

(see rules 30, 40); if the inventor be dead, the application may be made by the executor or administrator.

### *Inventor Believing Himself to be First Inventor*

27. If it appear that the inventor, at the time of making his application, believed himself to be the first inventor or discoverer, a patent will not be refused on account of the invention or discovery, or any part thereof, having been known or used in any foreign country before his invention or discovery thereof, if it had not been before patented or described in any printed publication.

### *Joint Inventors*

28. Joint inventors are entitled to a joint patent; neither of them can obtain a patent for an invention jointly invented by them. Independent inventors of distinct and independent improvements in the same machine can not obtain a joint patent for their separate inventions. The fact that one person furnishes the capital and another makes the invention does not entitle them to make an application as joint inventors; but in such case they may become joint patentees, upon the conditions prescribed in rule 26.

### *Foreign Patents*

29. No person otherwise entitled thereto shall be debarred from receiving a patent for his invention or discovery by reason of its having been first patented or caused to be patented by the inventor or his legal representatives or assigns in a foreign country, unless the application for said foreign patent was filed more than twelve months prior to the filing of the application in this country, in which case no patent shall be granted in this country.

An application for patent filed in this country by any person who has previously regularly filed an application for a patent for the same invention or discovery in a foreign country which, by treaty, convention, or law, affords similar privileges to citizens of the United States shall have the same force and effect as the same application would have if filed in this country on the date on which the application for patent for the same invention or discovery was first filed in such foreign country, provided the application in this country is filed within twelve months from the earliest date on which any such foreign application was filed; but no patent shall be granted upon such application if the invention or discovery has been patented or described in a printed publication in this or any foreign country, or has been in public use or on sale in this

country for more than two years prior to the date of filing in this country.

## The Application

### *Requisites of Application*

30. Applications for letters patent of the United States must be made to the Commissioner of Patents, and must be signed by the inventor, or by one of the persons indicated in rule 25. (See rules 26, 33, 40, 46.) A complete application comprises the first fee of *$30,* and *$1* for each claim in excess of 20, a petition, specification, and oath; and drawings, when required. (See rules 49 and 173.) The petition, specification, and oath must be in the English language. All papers which are to become a part of the permanent records of the office must be legibly written or printed in permanent ink.

31. An application for a patent will not be placed upon the files for examination until all its parts as required by rule 30 shall have been received.

### *Incomplete Application Not Filed*

Every application signed or sworn to in blank, or without actual inspection by the applicant of the petition and specification, and every application altered or partly filled up after being signed or sworn to, will be stricken from the files.

### *Present Series*

Complete applications are numbered in regular order, the present series having been commenced on the 1st of January, 1925.

The applicant will be informed of the serial number of his application.

### *Abandoned Unless Completed Within Six Months*

The application must be completed and prepared for examination within six months, as indicated above, and in default thereof, or upon the failure of the applicant to prosecute the same within six months after any action thereon (rule 77), of which notice shall have been duly mailed to him or his agent, the application will be regarded as abandoned, unless it shall be shown to the satisfaction of the Commissioner that such delay was unavoidable. (See rules 171 and 172.)

Where the day, or the last day, fixed by statute for taking any action or paying any fee falls on Sunday, or on a holiday within the District

of Columbia, the action may be taken, or the fee paid, on the next succeeding secular or business day.

### *All Parts of Application to be Filed Together*

32. It is desirable that all parts of the complete application be deposited in the office at the same time, and that all the papers embraced in the application be attached together; otherwise a letter must accompany each part, accurately and clearly connecting it with the other parts of the application. (See rule 10.)

## THE PETITION

33. The petition must be addressed to the Commissioner of Patents, and must state the name, residence, and post-office address of the petitioner requesting the grant of a patent, designate by title the invention sought to be patented, contain a reference to the specification for a full disclosure of such invention, and must be signed by the inventor or one of the persons indicated in rule 25.

## THE SPECIFICATION

34. The specification is a written description of the invention or discovery and of the manner and process of making, constructing, compounding, and using the same, and is required to be in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which the invention or discovery appertains, or with which it is most nearly connected, to make, construct, compound, and use the same.

### *Detailed Description*

35. The specification must set forth the precise invention for which a patent is solicited, and explain the principle thereof, and the best mode in which the applicant has contemplated applying that principle, in such manner as to distinguish it from other inventions.

### *Improvements*

36. In case of a mere improvement, the specification must particularly point out the parts to which the improvement relates, and must by explicit language distinguish between what is old and what is claimed as new; and the description and the drawings, as well as the claims, should be confined to the specific improvement and such parts as necessarily coöperate with it.

*Claims*

37. The specification must conclude with a specific and distinct claim or claims of the part, improvement, or combination which the applicant regards as his invention or discovery.

*Reference to Drawings*

38. When there are drawings the description shall refer to the different views by figures and to the different parts by letters or numerals (preferably the latter).

*Arrangement of Specification*

39. The following order of arrangement should be observed in framing the specification:

(*a*) Preamble stating the name, citizenship, and residence of the applicant and the title of the invention.

(*b*) General statement of the object and nature of the invention.

(*c*) Brief description of the several views of the drawing (if the invention admit of such illustration).

(*d*) Detailed description.

(*e*) Claim or claims.

(*f*) Signature of applicant.

*Signature to Specification*

40. The specification must be signed by the inventor or one of the persons indicated in rule 25. Full names must be given, and all names must be legibly written.

*Joinder of Inventions*

41. Two or more independent inventions can not be claimed in one application; but where several distinct inventions are dependent upon each other and mutually contribute to produce a single result they may be claimed in one application: *Provided,* That more than one species of an invention, not to exceed three, may be claimed in one application if that application also includes an allowable claim generic to all the claimed species. In the first action on an application containing a generic claim or claims and claims to more than one species thereunder the examiner, if he is of the opinion after a complete search that no generic claim presented is allowable, shall require the applicant in his response to that action to elect that species of his invention to which his claims shall be restricted if no generic claim is finally held allowable.

### *Division of Application*

42. If several inventions claimed in a single application be of such a nature that a single patent may not be issued to cover them, the inventor will be required to limit the description, drawing, and claim of the pending application to whichever invention he may elect. The other inventions may be made the subjects of separate applications, which must conform to the rules applicable to original applications. If the independence of the inventions be clear, such limitation will be made before any action upon the merits; otherwise it may be made at any time before final action thereon, in the discretion of the examiner. A requirement of division will not be repeated without the written approval of the examiner of classification. After a final requirement of division, the applicant may elect to prosecute one group of claims, retaining the remaining claims in the case with the privilege of appealing from the requirement of division after final action by the examiner on the group of claims prosecuted.

### *Cross-References in Cases Relating to Same Subject*

43. When an applicant files two or more applications relating to the same subject matter of invention, all showing but only one claiming the same thing, the applications not claiming it must contain references to the application claiming it.

### *Reservation Clauses Not Permitted*

44. A reservation for a future application of subject matter disclosed but not claimed in a pending application will not be permitted in the pending application.

### *Legible Writing Required*

45. The specification and claims must be plainly written or printed on but one side of the paper. All interlineations and erasures must be clearly referred to in marginal or foot notes on the same sheet of paper. Legal paper, 8 by 13 inches, with the lines numbered, is deemed preferable, and a wide margin must always be reserved upon the left-hand side of the page. In order to facilitate printing, each paragraph or claim should be completed on the page upon which it is begun and should not be split between two pages except where the length of a paragraph or claim requires more than one full page.

## THE OATH

### *Oath of Applicant*

46. The applicant, if the inventor, must make oath or affirmation that he does verily believe himself to be the original and first inventor or discoverer of the art, machine, manufacture, composition, or improvement, or of the variety of plant, for which he solicits a patent; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof, and shall state of what country he is a citizen and where he resides, and whether he is a sole or joint inventor of the invention claimed in his application. In every original application the applicant must distinctly state under oath that to the best of his knowledge and belief the invention has not been in public use or on sale in the United States for more than two years prior to his application, or patented or described in any printed publication in any country before his invention or more than two years prior to his application, or patented in any foreign country on an application filed by himself or his legal representatives or assigns more than twelve months prior to his application in this country. If any application for patent has been filed in any foreign country by the applicant in this country, or by his legal representatives or assigns, prior to his application in this country, he shall state the country or countries in which such application has been filed, giving the date of such application, and shall also state that no application has been filed in any other country or countries than those mentioned, and if no application for patent has been filed in any foreign country, he shall so state. This oath must be subscribed to by the affiant.

### *Oath by Executor or Guardian*

If the application be made by an executor or administrator of a deceased person or the guardian, conservator, or representative of an insane person, the oath shall allege the relationship of the affiant to the inventor and, upon information and belief, the facts which the inventor is required by this rule to make oath to.

### *Additional Oath*

The Commissioner may require an additional oath in cases where the applications have not been filed in the Patent Office within a reasonable time after the execution of the original oath.

### *Officers Authorized to Administer Oaths—Certificate of Notary*

47. The oath or affirmation may be made before any person within the United States authorized by law to administer oaths, or, when the applicant resides in a foreign country, before any minister, chargé d'affaires, consul, or commercial agent holding commission under the Government of the United States, or before any notary public, judge, or magistrate having an official seal and authorized to administer oaths in the foreign country in which the applicant may be, whose authority shall be proved by a certificate of a diplomatic or consular officer of the United States, the oath being attested in all cases in this and other countries, by the proper official seal of the officer before whom the oath or affirmation is made, except that no oath or affirmation may be administered by any attorney appearing in the case. When the person before whom the oath or affirmation is made in this country is not provided with a seal, his official character shall be established by competent evidence, as by a certificate from a clerk of a court of record or other proper officer having a seal.

When the oath is taken before an officer in a country foreign to the United States, all the application papers, except the drawings, must be attached together and a ribbon passed one or more times through all the sheets of the application, except the drawings, and the ends of said ribbon brought together under the seal before the latter is affixed and impressed, or each sheet must be impressed with the official seal of the officer before whom the oath is taken. If the papers as filed are not properly ribboned or each sheet impressed with the seal, the case will be accepted for examination, but before it is allowed, duplicate papers, prepared in compliance with the foregoing sentence, must be filed.

### *Supplemental Oath for Matter Not Originally Claimed*

48. When an applicant presents a claim for matter originally shown or described but not substantially embraced in the statement of invention or claim originally presented, he shall file a supplemental oath to the effect that the subject matter of the proposed amendment was part of his invention, was invented before he filed his original application, was not known or used before his invention, was not patented or described in a printed publication in any country more than two years before his application, was not patented in any foreign country on an application filed by himself or his legal representatives or assigns more than twelve months prior to his application, was not in public use or on sale in this country for more than two years before the date of his

application, and has not been abandoned. Such supplemental oath must be attached to and properly identify the proposed amendment.

In proper cases the oath here required may be made by an executor or administrator of a deceased person or a guardian conservator, or representative of an insane person. (See rule 46.)

### THE DRAWINGS

49. The applicant for a patent is required by law to furnish a drawing of his invention whenever the nature of the case admits of it.

#### *Requisites of Drawings*

50. The drawing may be signed by the inventor or one of the persons indicated in rule 25, or the name of the applicant may be signed on the drawing by his attorney in fact. The drawing must show every feature of the invention covered by the claims, and the figures should be consecutively numbered, if possible. When the invention consists of an improvement on an old machine the drawing must exhibit, in one or more views, the invention itself, disconnected from the old structure, and also in another view, so much only of the old structure as will suffice to show the connection of the invention therewith.

#### *Two Editions of Drawings*

51. Two editions of patent drawings are printed and published—one for office use, certified copies, etc., of the size and character of those attached to patents, the work being about 6 by 9½ inches; and one reduction of a selected portion of each drawing for the Official Gazette.

#### *Uniform Standard*

52. This work is done by the photolithographic process, and therefore the character of each original drawing must be brought as nearly as possible to a uniform standard of excellence, suited to the requirements of the process, to give the best results, in the interests of inventors, of the office, and of the public. The following rules will therefore be rigidly enforced, and any departure from them will be certain to cause delay in the examination of an application for letters patent:

#### *Paper and Ink*

(*a*) Drawings must be made upon pure white paper of a thickness corresponding to two-sheet or three-sheet Bristol board. The surface of the paper must be calendered and smooth. India ink alone must be used, to secure perfectly black and solid lines.

### *Size of Sheet and Marginal Lines*

(*b*) The size of a sheet on which a drawing is made must be exactly 10 by 15 inches. One inch from its edges a single marginal line is to be drawn, leaving the "sight" precisely 8 by 13 inches. Within this margin all work and signatures must be included. One of the shorter sides of the sheet is regarded as its top, and, measuring downwardly from the marginal line, a space of not less than $1\frac{1}{4}$ inches is to be left blank for the heading of title, name, number, and date.

### *Character and Color of Lines*

(*c*) All drawings must be made with the pen only. Every line and letter (signatures included) must be absolutely black. This direction applies to all lines, however fine, to shading, and to lines representing cut surfaces in sectional views. All lines must be clean, sharp, and solid, and they must not be too fine or crowded. Surface shading, when used, should be open. Sectional shading should be made by oblique parallel lines, which may be about one-twentieth of an inch apart. Solid black should not be used for sectional or surface shading. Free-hand work should be avoided wherever it is possible to do so.

### *Few Lines and Little or No Shading*

(*d*) Drawings should be made with the fewest lines possible consistent with clearness. By the observance of this rule the effectiveness of the work after reduction will be much increased. Shading (except on sectional views) should be used only on convex and concave surfaces, where it should be used sparingly, and may even there be dispensed with if the drawing be otherwise well executed. The plane upon which a sectional view is taken should be indicated on the general view by a broken or dotted line, which should be designated by numerals corresponding to the number of the sectional view. Heavy lines on the shade sides of objects should be used, except where they tend to thicken the work and obscure letters of reference. The light is always supposed to come from the upper left-hand corner at an angle of 45°.

### *Scale of Drawing*

(*e*) The scale to which a drawing is made ought to be large enough to show the mechanism without crowding, and two or more sheets should be used if one does not give sufficient room to accomplish this end; but the number of sheets must never be more than is absolutely necessary.

*Letters of Reference*

(*f*) The different views should be consecutively numbered. Letters and figures of reference must be carefully formed. They should, if possible, measure at least one-eighth of an inch in height, so that they may bear reduction to one twenty-fourth of an inch; and they may be much larger when there is sufficient room. They must be so placed in the close and complex parts of drawings as not to interfere with a thorough comprehension of the same, and therefore should rarely cross or mingle with the lines. When necessarily grouped around a certain part they should be placed at a little distance, where there is available space, and connected by lines with the parts to which they refer. They should not be placed upon shaded surfaces, but when it is difficult to avoid this, a blank space must be left in the shading where the letter occurs, so that it shall appear perfectly distinct and separate from the work. If the same part of an invention appear in more than one view of the drawing, it must always be represented by the same character, and the same character must never be used to designate different parts.

*Signature of Inventor—Title*

(*g*) The signature of the applicant should be placed at the lower right-hand corner of each sheet, and the signatures of the witnesses, if any, at the lower left-hand corner, all within the marginal line, but in no instance should they trespass upon the drawings. (See specimen drawing, appendix.) The title should be written with pencil on the back of the sheet. The permanent names and title constituting the heading will be applied subsequently by the office in uniform style.

*Large Views*

(*h*) All views on the same sheet must stand in the same direction and must, if possible, stand so that they can be read with the sheet held in an upright position. If views longer than the width of the sheet are necessary for the proper illustration of the invention, the sheet may be turned on its side. The space for heading must then be reserved at the right and the signatures placed at the left, occupying the same space and position as in the upright views and being horizontal when the sheet is held in an upright position. One figure must not be placed upon another or within the outline of another.

*Figure for Gazette*

(*i*) As a rule, one view only of each invention can be shown in the Gazette illustrations. The selection of that portion of a drawing best

calculated to explain the nature of the specific improvement would be facilitated and the final result improved by the judicious execution of a figure with express reference to the Gazette, but which must at the same time serve as one of the figures referred to in the specification. For this purpose the figure may be a plan, elevation, section, or perspective view, according to the judgment of the draftsman. All its parts should be especially open and distinct, with very little or no shading, and it must illustrate the invention claimed only, to the exclusion of all other details. (See specimen drawing.) When well executed it will be used without curtailment or change, but any excessive fineness or crowding or unnecessary elaborateness of detail will necessitate its exclusion from the Gazette.

*Drawings for Transmission*

(*j*) Drawings transmitted to the office should be sent flat, protected by a sheet of heavy binder's board; or should be rolled for transmission in a suitable mailing tube, but should never be folded.

*No Stamp, Advertisement, or Address Permitted on Face*

(*k*) An agent's or attorney's stamp, or advertisement, or written address will not be permitted upon the face of a drawing, within or without the marginal line.

*Drawings for Reissue Applications*

53. In reissue applications the drawings upon which the original patent was issued may be used upon the filing of suitable permanent photographic copies thereof, if no changes are to be made in the drawings.

*Defective Drawings*

54. The foregoing rules relating to drawings will be rigidly enforced. A drawing not executed in conformity thereto may be admitted for purposes of examination if it sufficiently illustrates the invention, but in such case the drawing must be corrected or a new one furnished before the application will be allowed. The necessary corrections will be made by the office, upon applicant's request and at his expense. (See rule 72.)

*Drawings Furnished by Office*

55. Applicants are advised to employ competent draftsmen to make their drawings.

The office will furnish the drawings at cost, as promptly as its draftsmen can make them, for applicants who can not otherwise conveniently procure them.

## The Model

### *Models, When Required*

56. A model will be required or admitted as a part of the application only when on examination of the case in its regular order the primary examiner shall find it to be necessary or useful. In such case, if a model has not been furnished, the examiner shall notify the applicant of such requirement, which will constitute an official action in the case. When a model has been received in compliance with the official requirement, the date of its filing shall be entered on the file wrapper. Models not required nor admitted will be returned to the applicants. When a model is required, the examination may be suspended until it shall have been filed.

### *Requisites of Model*

57. The model must clearly exhibit every feature of the machine which forms the subject of a claim of invention, but should not include other matter than that covered by the actual invention or improvement, unless it be necessary to the exhibition of the invention in a working model.

### *Material*

58. The model must be neatly and substantially made of durable material, metal being deemed preferable; but when the material forms an essential feature of the invention, the model should be constructed of that material.

### *Working Models*

59. A working model may be required if necessary to enable the office fully and readily to understand the precise operation of the machine.

### *Models in Rejected and Abandoned Cases*

60. In all applications which have become abandoned, the model, unless it be deemed necessary that it be preserved in the office, may be returned to the applicant upon demand and at his expense; and the model in any pending case may be returned to the applicant upon the

filing of a formal abandonment of the application, signed by the applicant in person and any assignee. (See rule 171.)

*Models in Patented Cases*

Models belonging to patented cases shall not be taken from the office except in the custody of some sworn employee of the office specially authorized by the Commissioner.

*Models Filed as Exhibits*

61. Models filed as exhibits in contested cases may be returned to the parties at their expense. If not claimed within a reasonable time, they may be disposed of at the discretion of the Commissioner.

SPECIMENS

62. When the invention or discovery is a composition of matter, the applicant, if required by the Commissioner, shall furnish specimens of the composition, and of its ingredients, sufficient in quantity for the purpose of experiment. In all cases where the article is not perishable, a specimen of the composition claimed, put up in proper form to be preserved by the office, must be furnished. (Rules 56, 60, and 61 apply to specimens also.)

THE EXAMINATION

*Order of Examination*

63. Applications filed in the Patent Office are classified according to the various arts, and are taken up for examination in regular order of filing, those in the same class of invention being examined and disposed of, so far as practicable, in the order in which the respective applications have been completed.

Applications which have been put into condition for further action by the examiner shall be entitled to precedence over new applications in the same class of invention.

*Privileged Cases*

The following cases have preference over all other cases at every period of their examination in the order enumerated:

(*a*) Applications wherein the inventions are deemed of peculiar importance to some branch of the public service, and when for that reason the head of some department of the Government requests immediate action and the Commissioner so orders; but in this case it shall be the

duty of the head of that department to be represented before the Commissioner in order to prevent the improper issue of a patent.

(*b*) Applications for reissues.

(*c*) Cases remanded by an appellate tribunal for further action, and statements of grounds of decisions provided for in rules 135 and 142.

(*d*) Applications which appear to interfere with other applications previously considered and found to be allowable, or which it is demanded shall be placed in interference with an unexpired patent or patents.

Where an applicant copies claims from a patent and the examiner is of the opinion that he can make none of these claims, he should state in his action why he can not make the claims and set a time limit, not less than twenty days, for reply. If, after response by the applicant, the rejection is made final, a similar time limit should be set for appeal. Failure to respond or appeal, as the case may be, within the time fixed, will in the absence of a satisfactory showing, be deemed a disclaimer of the invention claimed. (See rule 94.)

(*e*) Applications which have been renewed or revived, but the subject matter not changed.

Applications will not be advanced for examination excepting upon order of the Commissioner either to expedite the business of the office or upon a verified showing which in the opinion of the Commissioner will justify so advancing it.

### *Merits Treated Throughout*

64. Where the specification and claims are such that the invention may be readily understood the examination of a complete application and the action thereon will be directed throughout to the merits; but in each letter the examiner shall state or refer to all his objections.

### *At Last Form Insisted Upon*

Only in applications found by the examiner to present patentable subject matter and in applications on which appeal is taken to the board of appeals will requirements in matters of form be insisted on. (See rules 95 and 134.)

## Rejections and References

### *Notice of Rejection with Information and References*

65. Whenever, on examination, any claim of an application is rejected for any reason whatever, the applicant will be notified thereof.

The reasons for the rejection will be fully and precisely stated, and such information and references will be given as may be useful in aiding the applicant to judge of the propriety of prosecuting his application or of altering his specification, and if, after receiving this notice, he shall persist in his claim, with or without altering his specification, the application will be reëxamined. If upon reëxamination the claim shall be again rejected, the reasons therefor will be fully and precisely stated.

### *On Rejection for Want of Novelty*

66. Upon taking up an application for action on the merits the examiner shall make a thorough investigation of the prior art with respect to the invention sought to be protected in the application. Upon the rejection of an application for want of novelty, the examiner must cite the best references at his command. When the reference shows or describes inventions other than that claimed by the applicant, the particular part relied on must be designated as nearly as practicable. The pertinence of the reference, if not obvious, must be clearly explained and the anticipated claim specified.

### *Citation of Patents—Affidavits*

If domestic patents be cited, their dates and numbers, the names of the patentees, and the classes of inventions must be stated. If foreign patents be cited, their dates and numbers, the names of the patentees, and the classes of inventions must be stated, and such other data must be furnished as may be necessary to enable the applicant to identify the patents cited. In citing foreign patents the number of sheets of drawing involving the parts relied upon for anticipation must be specified, and in case part only of the patent be involved, the particular sheets of the drawing containing the parts relied upon must be identified by number, or by stating the numbers of the figures involved. If printed publications be cited, the title, date, page or plate, author, and place of publication, or place where a copy can be found, shall be given. When reference is made to facts within the personal knowledge of an employee of the office, the data shall be as specific as possible, and the reference must be supported, when called for, by the affidavit of such employee (rule 76); such affidavit shall be subject to contradiction, explanation, or corroboration by the affidavits of the applicant and other persons. If the patent, printed matter, plates, or drawings so referred to are in the possession of the office, copies will be furnished at the rate specified in rule 191, upon the order of the applicant.

*Adverse Decisions on Preliminary Questions in* ex parte *Cases*

67. Whenever in the treatment of an *ex parte* application an adverse decision is made upon any preliminary or intermediate question, without the rejection of any claim, notice thereof, together with the reasons therefor, will be given to the applicant in order that he may judge of the propriety of the action. If after receiving this notice he traverse the propriety of the action, the matter will be reconsidered.

## Amendments and Actions by Applicants

*Right to Amend—Requisites of Amendments*

68. The applicant has a right to amend before or after the first rejection or action, and he may amend as often as the examiner presents new references or reasons for rejection. In so amending the applicant must clearly point out all the patentable novelty which he thinks the case presents in view of the state of the art disclosed by the references cited or the objections made. He must also show how the amendments avoid such references or objections. In every instance where reconsideration is requested in view of an interview with the examiner or his assistant, the applicant or his attorney must file a written statement of the reasons presented at the interview as warranting favorable action.

*Amendment after Claims Ready for Appeal*

After such action upon an application as will entitle the applicant to an appeal to the board of appeals (rule 134), or after appeal has been taken, amendments canceling claims or presenting those rejected in better form for consideration on appeal may be admitted; but the admission of such an amendment or its refusal, and any proceedings relative thereto, shall not operate to relieve the application from its condition as subject to appeal or to save it from abandonment under rule 171.

If amendments touching the merits of the application be presented after the case is in condition for appeal, or after appeal has been taken, they may be admitted upon a showing, duly verified, of good and sufficient reasons why they were not earlier presented.

From the refusal of the primary examiner to admit an amendment a petition will lie to the Commissioner under rule 142.

No amendment can be made in appealed cases between the filing of the examiner's statement of the grounds of his decision (rule 135) and the decision of the appellate tribunal. After decision on appeal amend-

ments can only be made as provided in rule 140, or to carry into effect a recommendation under rule 139.

*Request for Reconsideration*

69. In order to be entitled to the reëxamination or reconsideration provided for in rules 65 and 67 the applicant must make request therefor in writing, and he must distinctly and specifically point out the supposed errors in the examiner's action; the applicant must respond to every ground of objection and rejection of the prior office action except as provided in rule 64, and the applicant's action must appear throughout to be a *bona fide* attempt to advance the case to final action. The mere allegation that the examiner has erred will not be received as a proper reason for such reëxamination or reconsideration.

*Amendments to Correspond to Original Drawing or Specification*

70. In original applications all amendments of the drawings or specifications, and all additions thereto, must conform to at least one of them as it was at the time of the filing of the application. Matter not found in either, involving a departure from the original invention, can not be added to the application even though supported by a supplemental oath, and can be shown or claimed only in a separate application.

*Inaccuracies or Prolixity—Change in Drawing*

71. The specification and drawing must be amended and revised when required, to correct inaccuracies of description or unnecessary prolixity, and to secure correspondence between the claim, the specification, and the drawing. But no change in the drawing may be made except by written permission of the office and after a photographic copy of the drawing as originally presented has been filed.

*Specification Not to Be Returned*

72. After the completion of the application the office will not return the specification for any purpose whatever. If applicants have not preserved copies of the papers which they wish to amend, the office will furnish them on the usual terms.

*Drawings Returned for Correction*

The drawing may be withdrawn only for such corrections as can not be made by the office; but a drawing can not be withdrawn unless a photographic copy has been filed and accepted by the examiner as a

part of the application. Permissible changes in the construction shown in any drawing may be made only by the office and after an approved photographic copy has been filed. Sketches filed to show proposed changes in construction must be in permanent ink. (See rule 30.) Substitute drawings will not be admitted in any case unless required by the office.

### *Amendments Must Be Specific—How Written*

73. In every amendment the exact word or words to be stricken out or inserted in the application must be specified and the precise point indicated where the erasure or insertion is to be made. All such amendments must be on sheets of paper separate from the papers previously filed, and written on but one side of the paper. Erasures, additions, insertions, or mutilations of the papers and records must not be made by the applicant.

The original numbering of the claims must be preserved throughout the prosecution. When the application is ready for allowance the examiner will renumber the claims consecutively in such order as requested by the applicant or as indicated when the claims were first presented. Where claims are added by amendment or substituted for canceled claims they must be numbered by the applicant consecutively, beginning with the number next following the highest numbered claim previously in the case. *Provided, however,* that where a substitute claim either rewritten to include amendments already made, or to take the place of another claim, is presented and the applicant desires it to finally appear in the relative position occupied by the canceled claim, the substitute claim will be given the number it would have if it were an added claim, and the number will be followed by a directing clause as, for example: Claim 16 (to take the place of claim 3), or claim 24 (to follow claim 2). When, by subsequent amendment, still another claim is substituted for a substitute claim already presented, such last presented claim should be given the number following the highest numbered claim previously in the case and this should be followed by such a directing clause as will indicate the desired final position of the claim with respect to the other claims.

### *Signature to Amendments*

Amendments and papers requiring the signature of the applicant must also, in case of assignment of an undivided part of the invention, be signed by the assignee. (Rules 6, 107.)

*Specification Rewritten*

74. When an amendatory clause is amended it must be wholly rewritten, so that no interlineation or erasure shall appear in the clause as finally amended, when the application is passed to issue. If the number or nature of the amendments shall render it otherwise difficult to consider the case, or to arrange the papers for printing or copying, the examiner or Commissioner may require the entire specification to be rewritten

*Patents Showing but not Claiming Invention, and Other References Overcome by Affidavit as to Prior Invention*

75. When an original or reissue application is rejected on reference to an expired or unexpired domestic patent which substantially shows or describes but does not claim the rejected invention, or on reference to a foreign patent or to a printed publication, and the applicant shall make oath to facts showing a completion of the invention in this country before the filing of the application on which the domestic patent issued, or before the date of the foreign patent, or before the date of the printed publication, and shall also make oath that he does not know and does not believe that the invention has been in public use or on sale in this country, or patented or described in a printed publication in this or any foreign country for more than two years prior to his application, and that he has never abandoned the invention, then the patent or publication cited shall not bar the grant of a patent to the applicant, unless the date of such patent or printed publication be more than two years prior to the date on which application was filed in this country.

*Affidavit Supporting or Traversing Such References or Objections May be Received*

76. When an application is rejected on reference to an expired or unexpired domestic patent which shows or describes but does not claim the invention, or on reference to a foreign patent, or to a printed publication, or to facts within the personal knowledge of an employee of the office, set forth in an affidavit (when requested) of such employee (rule 66), or when rejected on the ground of public use or sale, or upon a mode or capability of operation attributed to a reference or because the alleged invention is held to be inoperative or frivolous or injurious to public health or morals, affidavits or depositions supporting or traversing these references or objections may be received, but affidavits will not be received in other cases without special permission of the Commissioner. (See rule 138.)

*Abandonment*

77. If an applicant neglects to prosecute his application for six months after the date when the last official notice of any action by the office was mailed to him, the application will be held to be abandoned, as set forth in rule 171.

*Suspension of Application*

Whenever action upon an application is suspended upon request of an applicant, and whenever an applicant has been called upon to put his application in condition for interference, the period of six months running against the application shall be considered as beginning at the date of the last official action preceding such actions.

Suspensions will only be granted for good and sufficient cause, and for a reasonable time specified. Only one suspension may be granted by the primary examiner; any further suspension must be approved by the Commissioner.

Whenever, during a time when the United States is at war, publication of an invention by the granting of a patent might, in the opinion of the Commissioner, be detrimental to the public safety or defense or might assist the enemy or endanger the successful prosecution of the war, he may suspend action on the application therefor.

*Amendment after Notice of Allowance without Withdrawal from Issue*

78. Amendments after the notice of allowance of an application will not be permitted as a matter of right, but may be made, if the specification has not been printed, on the recommendation of the primary examiner, approved by the Commissioner, without withdrawing the case from issue. (See rule 165.)

DESIGNS

*Design Patents, to Whom Granted*

79. A design patent may be obtained by any person who has invented any new, original, and ornamental design for an article of manufacture, not known or used by others in this country before his invention thereof, and not patented or described in any printed publication in this or any foreign country before his invention thereof, or more than two years prior to his application, and not caused to be patented by him in a foreign country on an application filed more than four months before

his application in this country, and not in public use or on sale in this country for more than two years prior to his application, unless the same is proved to have been abandoned, upon payment of the fees required by law and other due proceedings had, the same as in cases of inventions or discoveries.

### *Terms of Design Patents*

80. Patents for designs are granted for the term of three and one-half years, or for seven years, or for fourteen years, as the applicant may, in his application, elect.

Where the applicant requests that the patent issue for one of the shorter terms, he may, at any time before the allowance of the application, upon the payment of the additional fee, amend his application by requesting that the patent be issued for a longer term.

### *Proceedings*

81. The proceedings in applications for patents for designs are substantially the same as in applications for other patents. Since a design patent gives to the patentee the exclusive right to make, use, and vend articles having the appearance of that disclosed, and since the appearance can be disclosed only by a picture of the article, the claim should be in the broadest form for the article as shown.

### *Arrangement of Specification*

82. The following order of arrangement should be observed in framing design specifications:

(*a*) Preamble, stating name and residence of the applicant, title of the design, and the name of the article for which the design has been invented.

(*b*) Description of the figure or figures of the drawing.

(*c*) Claim.

(*d*) Signature of applicant.

### *Drawings*

83. When the design can be sufficiently represented by drawings a model will not be required.

84. The design must be represented by a drawing made to conform to the rules laid down for drawings of mechanical inventions.

## Reissues

### *Reissue, When Granted*

85. A reissue is granted when the original patent is inoperative or invalid by reason of a defective or insufficient specification, or by reason of the patentee claiming as his invention or discovery more than he had a right to claim as new, provided the error has arisen through inadvertence, accident, or mistake, and without any fraudulent or deceptive intention.

Reissue applications must be made and the specifications sworn to by the inventors if they be living.

### *Abstract of Title—Assent of Assignees*

86. The petition for a reissue must be accompanied by an order for a certified copy of the abstract of title, to be placed in the file, giving the names of all assignees owning any undivided interest in the patent. In case the application be made by the inventor it must be accompanied by the written assent of such assignees.

A reissue will be granted to the original patentee, his legal representatives or assigns, as the interest may appear.

### *Prerequisites—Oath of Applicant for Reissue*

87. Applicants for reissue, in addition to the requirements of the first sentence of rule 46, must also file with their petitions a statement on oath as follows:

(*a*) That applicant verily believes the original patent to be inoperative or invalid, and the reason why.

(*b*) When it is claimed that such patent is so inoperative or invalid "by reason of a defective or insufficient specification," particularly specifying such defects or insufficiencies.

(*c*) When it is claimed that such patent is inoperative or invalid "by reason of the patentee claiming as his own invention or discovery more than he had a right to claim as new," distinctly specifying the part or parts so alleged to have been improperly claimed as new.

(*d*) Particularly specifying the errors which it is claimed constitute the inadvertence, accident, or mistake relied upon, and how they arose or occurred.

(*e*) That said errors arose "without any fraudulent or deceptive intention" on the part of the applicant.

*New Matter*

88. New matter shall not be allowed to be introduced into the reissue specification, nor in the case of a machine shall the model or drawings be amended except each by the other.

*Division of Reissue of Application*

89. The Commissioner may, in his discretion, cause several patents to be issued for distinct and separate parts of the thing patented, upon demand of the applicant, and upon payment of the required fee for each division of such reissued letters patent. Each division of a reissue constitutes the subject of a separate specification descriptive of the part or parts of the invention claimed in such division; and the drawing may represent only such part or parts, subject to the provisions of rule 50. Unless otherwise ordered by the Commissioner, all the divisions of a reissue will issue simultaneously; if there be any controversy as to one division, the others will be withheld from issue until the controversy is ended, unless the Commissioner shall otherwise order.

*Reëxamination of Reissue Claims*

90. An original claim, if reproduced in the reissue specification, is subject to reëxamination, and the entire application will be revised and restricted in the same manner as original applications, excepting that division will not be required.

*Original Patent*

91. The application for a reissue must be accompanied by an offer to surrender the original patent. The application should also be accompanied by the original patent, or, if the original is lost or inaccessible, by an affidavit to that effect. The application may be accepted for examination in the absence of the original patent or the affidavit, but one or the other must be supplied before the case is allowed. If a reissue be refused, the original patent will be returned to applicant upon his request.

When an application for a reissue is filed, the examiner will place in the files of the original patent a notice stating that an application for reissue has been filed and the date it was filed. When the reissue is granted or the reissue application is otherwise terminated, that fact will be added to the notice in the file of the original patent.

*Matter to Be Claimed Only in a Reissue*

92. Matter shown and described in an unexpired patent which is an indivisible part of the invention claimed therein, but which was not

claimed by reason of a defect or insufficiency in the specification, arising from inadvertence, accident, or mistake, and without fraud or deceptive intent, can not be subsequently claimed by the patentee in a separate patent, but only in a reissue of the original patent.

## Interferences

### *Interference Defined*

93. An interference is a proceeding instituted for the purpose of determining the question of priority of invention between two or more parties claiming substantially the same patentable invention and may be instituted as soon as it is determined that common patentable subject matter is claimed in a plurality of applications or in an application and a patent. In order to ascertain whether any question of priority arises the Commissioner may call upon any junior applicant to state in writing the date when he conceived the invention under consideration. All statements filed in compliance with this rule will be returned to the parties filing them. In case the junior applicant makes no reply within the time specified, not less than ten days, the Commissioner will proceed upon the assumption that the said date is the date of the oath attached to the application. The fact that one of the parties has already obtained a patent will not prevent an interference, for, although the Commissioner has no power to cancel a patent, he may grant another patent for the same invention to a person who proves to be the prior inventor.

### *When Declared*

94. Interferences will be declared between applications by different parties for patent or for reissue when such applications contain claims for substantially the same invention which are allowable in the application of each party, and interferences will also be declared between applications for patent, or for reissue, and unexpired original or reissued patents, of different parties, when such applications and patents contain claims for substantially the same invention which are allowable in all of the applications involved: *Provided,* That where the filing date of any applicant is subsequent to the filing date of any patentee, the applicant shall file an affidavit that he made the invention in controversy before the filing date of the patentee.

### *Claims Copied from a Patent*

Where claims are copied from a patent and the examiner is of the opinion that the applicant can make only some of the claims so copied,

he shall notify the applicant to that effect, state why he is of the opinion he can not make the other claims and state further that the interference will be promptly declared and that the applicant may proceed under rule 109, if he further desires to contest his right to make the claims not included in the declaration of the interference.

Where an applicant presents a claim copied or substantially copied from a patent, he must identify the patent, give the number of the patented claim, and specifically apply the terms of the copied claim to his own disclosure.

An amendment containing a claim copied from a patent granted more than two years prior to the filing of such amendment shall not be entered unless it be accompanied by a statement specifically pointing out the claim or claims upon which the applicant relies to show that he was claiming the subject matter of the copied claim or claims within two years from the date of the patent.

*Applications Owned by Same Party*

Parties owning applications or patents which contain conflicting claims will be required before an interference is declared to show cause why these claims shall not be eliminated from all but one of the applications or patents of common ownership.

*Preparation for Interference*

95. Before the declaration of interference it must be determined that there is common patentable subject matter in the cases of the respective parties. The issue must be clearly defined and be patentable to the respective parties, subject to the determination of the question of priority.

In case the subject matter in controversy has been patented to one of the parties but is deemed by the examiner not to be patentable to an applicant, he shall call the case to the attention of the Commissioner.

*Suggestion of Claims for Interference*

96. Whenever the claims of two or more applications differ in phraseology, but relate to substantially the same patentable subject matter, the examiner shall suggest to the parties such claims as are necessary to cover the common invention in substantially the same language. The examiner shall send copies of the letter suggesting claims to the applicant and to the assignee, as well as to the attorney of record in each case. The parties to whom the claims are suggested will be required to make those claims within a specified time in order that an interference may be declared. Upon the failure of any applicant to make any claim suggested

within the time specified, such failure or refusal shall be taken without further action as a disclaimer of the invention covered by that claim unless the time be extended upon a proper showing. After judgment of priority the application of any party may be held for revision and restriction, subject to interference with other applications.

*Conflicting Parties Having the Same Counsel Notified*

Whenever it shall be found that two or more parties whose interests are in conflict are represented by the same attorney, the examiner shall notify each of said principal parties and also the attorney of this fact.

*Examiner Preparing Interference Notices, etc.*

97. When an interference is found to exist and the applications are prepared therefor, the primary examiner shall forward to the examiner of interferences the files and drawings; notices of interference for all the parties (as specified in rule 103) disclosing the name and residence of each party and those of his attorney, and of any assignee, and, if any party be a patentee, the date and number of the patent; the ordinals of the conflicting claims and the title of the invention claimed; and the issue, which shall be clearly and concisely defined in so many counts or branches as may be necessary in order to include all interfering claims. Where the issue is stated in more than one count the respective claims involved in each count shall be specified. The primary examiner shall also forward to the examiner of interferences for his use a statement disclosing the applications involved in interference, fully identified, arranged in the inverse chronological order of the filing of the completed applications, and also disclosing the issue or issues and the ordinals of the conflicting claims, the name and residence of any assignee, and the names and residences of all attorneys, both principal and associate.

*Revision of Notices by Examiner of Interferences*

98. Upon receipt of the notices of interference, the examiner of interferences shall make an examination thereof, in order to ascertain whether the issues between the parties have been clearly defined, and whether they are otherwise correct. If he be of the opinion that the notices are ambiguous or are defective in any material point, he shall transmit his objections to the primary examiner, who shall promptly notify the examiner of interferences of his decision to amend or not to amend them.

*Reference to Commissioner*

99. In case of a material disagreement between the examiner of interferences and the primary examiner, the points of difference shall be referred to the Commissioner for decision.

*Primary Examiner Retains Jurisdiction*

100. The primary examiner will retain jurisdiction of the case until the declaration of interference is made.

*Jurisdiction of Examiner of Interferences*

101. Upon the institution and declaration of the interference, as provided in rule 102, the examiner of interferences will take jurisdiction of the same, which will then become a contested case.

*Institution and Declaration of Interference*

102. When the notices of interference are in proper form, the examiner of interferences shall add thereto a designation of the time within which the preliminary statements required by rule 110 must be filed, and shall, *pro forma,* institute and declare the interference by forwarding the notices to the several parties to the proceeding.

*Notices to Parties*

103. The notices of interference shall be forwarded by the examiner of interferences to all the parties, in care of their attorneys, if they have attorneys, and, if the application or patent in interference has been assigned, to the assignees. When one of the parties has received a patent, a notice shall be sent to the patentee and to his attorney of record.

*Publication in Official Gazette*

When the notices sent in the interest of a patent are returned to the office undelivered, or when one of the parties resides abroad and his agent in the United States is unknown, additional notice may be given by publication in the Official Gazette for such period of time as the Commissioner may direct.

*Motion for Postponement of Time for Filing*

104. If either party require a postponement of the time for filing his preliminary statement, he shall present his motion, duly served on the other parties, with his reasons therefor, supported by affidavit, and such

motion should be made, if possible, prior to the day previously set. But the examiner of interferences may, in his discretion, extend the time on *ex parte* request or upon his own motion.

*Certified Copies Used in Interference Proceedings*

105. When an application is involved in an interference in which a part only of the invention is included in the issue, the applicant may file certified copies of the part or parts of the specification, claims, and drawings which cover the interfering matter, and such copies may be used in the proceeding in place of the original application.

*New Application for Claims Not in Interference*

106. When a part only of an application is involved in an interference, the applicant may withdraw from his application the subject matter adjudged not to interfere, and file a new application therefor, or he may file a divisional application for the subject matter involved, if the invention can be legitimately divided: *Provided,* That no claim shall be made in the application not involved in the interference broad enough to include matter claimed in the application involved therein.

*Disclaimer to Avoid Interference*

107. An applicant or a patentee involved in an interference may at any time file a written disclaimer or concession of priority, or abandonment of the invention, signed by the inventor in person with the written consent of the assignee when there has been an assignment. Upon the filing of such an instrument by any party, judgment shall be rendered against him.

*Abandonment of the Contest*

An applicant, except an applicant for reissue having claims from his patent in the interference, may at any time prior to the taking of testimony avoid the continuance of the interference by filing a written abandonment of the contest, signed by the inventor in person with the written consent of the assignee when there has been an assignment. Upon the filing of such abandonment of the contest the interference shall be dissolved as to that party.

Upon a showing of sufficient cause, the disclaimer, or abandonment of the invention, or abandonment of the contest, above referred to, may be executed and filed by the assignee of the entire interest.

Where an interference is terminated as provided herein, the *ex parte* proceedings shall be in accordance with rule 132.

### *Inspection of Claims of Opposing Parties*

108. After the preliminary statements referred to in rule 110 have been received and approved the parties will be permitted to see or obtain copies of each other's file wrappers, and so much of their contents as relates to the interference but the preliminary statements shall not be revealed to the opposing parties except as provided in rule 111.

### *Motion to Amend Interference—As to New Claims*

109. An applicant involved in an interference may, within a time fixed by the examiner of interferences not less than thirty days after the preliminary statements (referred to in rule 110) of the parties have been received and approved, or if a motion to dissolve the interference has been brought by another party, within thirty days from the filing thereof, on motion duly made as provided by rule 153, file an amendment to his application containing any claims which in his opinion should be made the basis of interference between himself and any of the other parties.

### *Hearing Before Primary Examiner*

Such motion must be accompanied by the proposed amendment, and when in proper form will be set by the examiner of interferences for hearing before the primary examiner. Where a party opposes the admission of such an amendment in view of prior patents or publications, full notice of such patents or publications, applying them to the proposed counts, must be given to all parties at least twenty days prior to the date of hearing. On the admission of such amendment and the adoption of the claims by the other parties within a time specified the primary examiner shall redeclare the interference or shall declare such other interferences as may be necessary to include the said claims. New preliminary statements will be received as to the added claims, but motions for dissolution with regard thereto will not be considered where the questions raised could have been disposed of in connection with the admission of the claims. Amendments to the specification will not be received during the pendency of the interference without the consent of the Commissioner, except as provided herein and in rule 106.

### *As to Claims Already in Application—As to Other Applications or Patents Owned by a Party*

Any party to an interference may bring a motion to put in interference any claims already in his application or patent which should be

made the basis of interference between himself and any of the other parties. Any party to an interference may bring a motion to add or substitute any other application owned by him, as to the existing issue, or to include an application or a patent owned by him, as to claims which should be made the basis of interference between himself and any of the other parties. Such motions are subject to the same conditions and the procedure in connection therewith is the same, so far as applicable, as hereinabove set forth for motions to amend.

*Preliminary Statements*

110. Each party to the interference will be required to file a concise preliminary statement, under oath, on or before a date to be fixed by the office, showing the following facts:

(*a*) The date of original conception of the invention set forth in the declaration of interference.

(*b*) The date upon which the first drawing of the invention and the date upon which the first written description of the invention were made.

(*c*) The date upon which the invention was first disclosed to others.

(*d*) The date of the reduction to practice of the invention.

(*e*) The date when he began actively exercising reasonable diligence in adapting and perfecting the invention.

(*f*) The applicant shall state the date and number of any application for the same invention filed within twelve months before the filing date in the United States, in any foreign country adhering to the International Convention for the Protection of Industrial Property or having similar treaty relations with the United States.

If a drawing has not been made, or if a written description of the invention has not been made, or if the invention has not been reduced to practice or disclosed to others, the statement must specifically disclose these facts.

When the invention was made abroad the statement should set forth:

(*a*) That the applicant made the invention set forth in the declaration of interference.

(*b*) Whether or not the invention was ever patented; if so, when and where, giving the date and number of each patent, the date of publication, and the date of sealing thereof.

(*c*) Whether or not the invention was ever described in a printed publication; if so, when and where, giving the title, place, and date of such publication.

(*d*) When the invention was introduced into this country, giving the

circumstances with the dates connected therewith which are relied upon to establish the fact.

The preliminary statements should be carefully prepared, as the parties will be strictly held in their proofs to the dates set up therein.

If a party prove any date earlier than alleged in his preliminary statement, such proof will be held to establish the date alleged and none other.

The statement must be sealed up before filing (to be opened only by the examiner of interferences; see rule 111), and the name of the party filing it, the title of the case, and the subject of the invention indicated on the envelope. The envelope should contain nothing but this statement.

*When Opened to Inspection*

111. The preliminary statements shall not be opened to the inspection of the opposing parties until all motions to dissolve under rule 122 and all motions to amend under rule 109 and interlocutory appeals respecting the same have been finally disposed of or the time for filing such motions has expired without such a motion having been filed, and the case is in condition for taking of testimony.

A junior party who fails to file a preliminary statement or a party who alleges no date in his preliminary statement earlier than the filing date of the application or applications of another party shall not have access to the preliminary statement of said party.

If the interference be terminated by dissolution, the preliminary statements will remain sealed.

*Notice to Amend Preliminary Statement—Unopened Statement*

112. If, on examination, a statement is found to be defective in any particular, the party shall be notified of the defect and wherein it consists, and a time assigned within which he must cure the same by an amended statement; but in no case will the original or amended statement be returned to the party after it has been filed. Unopened statements will be removed from interference files and preserved by the office, and in no case will such statements be opened to the inspection of the opposing party without authority from the Commissioner. If a party shall refuse to file an amended statement he may be restricted to his record date in the further proceedings in the interference.

*Motion to Amend Preliminary Statement*

113. In case of material error arising through inadvertence or mistake, the statement may be corrected on motion (see rule 153), upon a

satisfactory showing that the correction is essential to the ends of justice. The motion to correct the statement must be made, if possible, before the taking of any testimony, and as soon as practicable after the discovery of the error.

### *Failure to File Preliminary Statement—Failure to Overcome* prima facie *Case*

114. If the junior party to an interference, or if any party thereto other than the senior party, fail to file a statement, or if his statement fail to overcome the *prima facie* case made by the respective dates of application, such party shall be notified by the examiner of interferences that judgment upon the record will be rendered against him at the expiration of a time fixed by the examiner of interferences, not less than thirty days, unless cause be shown why such action should not be taken. Within this period any of the motions permitted by the rules may be brought, except a motion by such junior party denying the patentability of any claim constituting a count of the interference: *Provided, however,* That where a patent is not involved such junior party may file a statement as to his reasons for considering such claim or claims unpatentable, which statement shall be given due consideration by the primary examiner after the termination of the interference before passing the application of the successful party to issue. Motions brought after judgment on the record has been rendered will not be entertained unless sufficient reasons appear for the delay.

### *Failure to File Statement; Testimony Excluded*

115. If a party to an interference fail to file a statement, testimony will not be received subsequently from him to prove that he made the invention at a date prior to his application.

116. The parties to an interference will be presumed to have made their inventions in the chronological order in which they filed their completed applications for patents clearly disclosing same; and the burden of proof will rest upon the party who shall seek to establish a different state of facts.

The termination of the interference by dissolution under rule 122 without an award of priority shall not disturb this presumption, and a party enjoying the status of a senior party with respect to any subject matter of his application shall not be deprived of any claim to such subject matter solely on the ground that such claim was not added to the interference by amendment under rule 109.

*Statement not Evidence*

117. The preliminary statement can in no case be used as evidence in behalf of the party making it.

*Time for Taking Testimony*

118. Times will be assigned in which the junior applicant shall complete his testimony in chief, and in which the other party shall complete the testimony on his side, and a further time in which the junior applicant may take rebutting testimony; but he shall take no other testimony. If there be more than two parties to the interference, the times for taking testimony will be so arranged that each shall have an opportunity to prove his case against prior applicants and to rebut their evidence, and also to meet the evidence of junior applicants.

*Failure to Take Testimony*

119. Upon the filing of an affidavit by any senior party to an interference that the time for taking testimony on behalf of any junior party has expired and that no testimony has been taken by him, an order shall be entered that the junior party show cause within a time set therein, not less than ten days, why judgment should not be rendered against him, and in the absence of a showing of good and sufficient cause judgment shall be so rendered. If any showing be made in response to the order, it must be served upon the opposing party and noticed for hearing by the party filing it.

*Postponement of Hearing*

120. If either party desire to have the hearing continued, he shall make application for such postponement by motion (see rule 153), and shall show sufficient reason therefor by affidavit.

*Enlargement of Time for Taking Testimony*

121. If either party desire an extension of the time assigned to him for taking testimony, he shall make application therefor, as provided in rule 154 (*d*).

*Motion to Dissolve for Irregularity, Nonpatentability, Etc.*

122. Motions to dissolve an interference (1) alleging that there has been such informality in declaring the same as will preclude the proper determination of the question of priority of invention, or (2) denying

the patentability of an applicant's claim, or (3) denying his right to make the claim, or (4) if the interference involves a design patent or an application, alleging that there is no interference in fact and also motions to shift the burden of proof, should contain a full statement of the grounds relied upon and should, if possible, be made within the time fixed by the examiner of interferences, not less than thirty days, after the statements of the parties have been received and approved. Such motions and all motions of a similar character, if in the opinion of the examiner of interferences they be in proper form, will be heard and determined by the primary examiner, due notice of the day of hearing being given by the office to all parties. If in the opinion of the examiner of interferences the motion be not in proper form, or if it be not brought within the time specified and no satisfactory reason be given for the delay, it will not be considered and the parties will be so notified.

At a hearing on a motion to dissolve an interference between an application and a patent, the prior art of record in the patent file shall be referred to for the purpose of construing the issue. No interlocutory appeal from the decision on a motion to shift the burden of proof will be entertained, but the matter may be reviewed at final hearing and on appeal.

### *Motions to Effect Stay of Proceedings*

123. Setting a motion brought under the provisions of rule 109 or of rule 122 for hearing will act as a stay of proceedings pending the determination of the motion. To effect a stay of proceedings in other cases, motion should be made before the tribunal having jurisdiction of the interference, who will, sufficient grounds appearing therefor, order a suspension of the interference pending the determination of such motion.

### *Appeals from Adverse Decision*

124. Where, on motion for dissolution, the primary examiner renders an adverse decision upon the merits of a party's case, as when he holds that the issue is not patentable or that a party has no right to make a claim, he shall fix a limit of appeal not less than twenty days from the date of his decision. Appeal lies to the board of appeals and will be heard *inter partes*. If the appeal be not taken within the time fixed, it will not be entertained except by permission of the Commissioner.

No appeal will be permitted from a decision rendered upon motion for dissolution affirming the patentability of a claim or the applicant's right to make the same.

Appeals may be taken directly to the Commissioner, except in the cases provided for in the preceding portions of this rule, from decisions on such motions as, in his judgment, should be appealable.

*Determination*

125. After an interference is finally declared it will not, except as herein otherwise provided, be determined without judgment of priority founded either upon the evidence, or upon a written concession of priority, or upon a written disclaimer of the invention, or upon a written declaration of abandonment of the invention, signed by the inventor himself (and by the assignee, if any).

*Statutory Bar Suggested—How Determined*

126. The examiner of interferences or the board of appeals may, either before or in their decision on the question of priority, direct the attention of the Commissioner to any matter not relating to priority which may have come to their notice, and which, in their opinion, establishes the fact that no interference exists, or that there has been irregularity in declaring the same (rule 122), or which amounts to a statutory bar to the grant of a patent to either of the parties for the claim or claims in interference. The Commissioner may suspend the interference and remand the case to the primary examiner for his consideration of the matters to which attention has been directed. From the decision of the examiner appeal may be taken as in other cases. If the case shall not be so remanded, the primary examiner will, after judgment, consider any matter affecting the rights of either party to a patent which may have been called to his attention, unless the same shall have been previously disposed of by the Commissioner.

*Second Interference*

127. A second interference will not be declared upon a new application for the same invention filed by either party.

*Suspension of Interference for Consideration of New References*

128. If, during the pendency of an interference, a reference be found which in the opinion of the primary examiner renders all or part of the interfering subject matter unpatentable, the attention of the examiner of interferences shall be called thereto. The examiner of interferences may suspend the interference and refer the case to the primary examiner for his determination of the question of patentability, and the interference shall be dissolved or continued in accordance with such determina-

tion. The consideration of such reference by the primary examiner shall be *inter partes.*

*For Addition of New Parties*

129. If, during the pendency of an interference, another case appear, claiming substantially the subject matter in issue, the primary examiner shall request the suspension of the interference for the purpose of adding said case. Such suspension will be granted as a matter of course by the examiner of interferences if no testimony has been taken. If, however, any testimony has been taken, a notice for the proposed new party, disclosing the issue in interference and the names and addresses of the interferants and of their attorneys, and notices for the interferants disclosing the name and address of the said party and his attorney, shall be prepared by the primary examiner and forwarded to the examiner of interferences, who shall mail said notices and set a time of hearing on the question of the admission of the new party. If the examiner of interferences be of the opinion that the interference should be suspended and the new party added, he shall prescribe the terms for such suspension. The decision of the examiner of interferences as to the addition of a party shall be final.

*Nonpatentability of Claim to Opponent as Basis for Priority*

130. Where the patentability of a claim to an opponent is material to the right of a party to a patent, said party may urge the nonpatentability of the claim to his opponent as a basis for the decision upon priority of invention. A party shall not be entitled to raise this question, however, unless he has duly presented and prosecuted a motion under rule 122 for dissolution upon this ground or shows good reason why such a motion was not presented and prosecuted. When the primary examiner has denied such a motion for dissolution the question shall not be reinvestigated by the examiner of interferences except in view of evidence which was not before the primary examiner when the motion was considered, but it may be raised before the appellate tribunals on appeal from the award of priority.

At final hearing between an application and a patent the prior art of record in the patent file shall be referred to for the purpose of construing the issue.

*Prosecution or Defense by Assignee*

131. When, on motion duly made and upon satisfactory proof, it shall be shown that, by reason of the inability or refusal of the inventor to

prosecute or defend an interference, or from other cause, the ends of justice require that an assignee of an undivided interest in the invention be permitted to prosecute or defend the same, it may be so ordered.

### *Claims of Defeated Parties*

132. Whenever an award of priority has been rendered in an interference proceeding by any tribunal and the limit of appeal from such decision has expired, and whenever an interference has been terminated as provided in rule 107, the primary examiner shall advise the defeated or unsuccessful party or parties to the interference that their claim or claims which were so involved in the issue stand finally rejected.

## Appeals to the Board of Appeals and Petitions to the Commissioner in the Ex Parte Prosecution of Applications

### *Appeal to Board of Appeals*

133. Every applicant for a patent, any of the claims of whose application have been twice rejected for the same reasons, upon grounds involving the merits of the invention, such as lack of invention, novelty, or utility, or on the ground of abandonment, public use or sale, inoperativeness of invention, aggregation of elements, incomplete combination of elements, or, when amended, for want of identity with the invention originally disclosed, or because the amendment involves a departure from the invention originally presented; and every applicant who has been twice required to divide his application, and every applicant for the reissue of a patent whose claims have been twice rejected for any of the reasons above enumerated, or on the ground that the original patent is not inoperative or invalid, or if so inoperative or invalid that the errors which rendered it so did not arise from inadvertence, accident, or mistake, may, upon payment of a fee of $15, appeal from the decision of the primary examiner to the board of appeals. The appeal must set forth in writing the points of the decision upon which it is taken, and must be signed by the applicant or his duly authorized attorney or agent.

### *Prerequisites*

134. There must have been two rejections of the claims as originally filed, or, if amended in matter of substance, of the amended claims, and all the claims must have been passed upon, and except in cases of division all preliminary and intermediate questions relating to matters not affecting the merits of the invention settled, before the case can be appealed to the board of appeals.

*Examiner's Statement of Grounds of Decision*

135. Upon the filing of the appeal the same shall be submitted to the primary examiner, who, if he find it to be regular in form, and to relate to an appealable action, shall within ten days from the filing thereof furnish the board of appeals with a written statement of the grounds of his decision on all the points involved in the appeal, with copies of the rejected claims and with the references applicable thereto, giving a concise explanation of the invention claimed and of the subject matter of the references so far as pertinent to the appealed claims. The examiner shall at the time of making such statement furnish a copy of the same to the appellant. If the primary examiner shall decide that the appeal is not regular in form or does not relate to an appealable action, a petition from such decision may be taken directly to the Commissioner, as provided in rule 142.

136. Rule canceled.

*Oral Hearing Before Board of Appeals*

137. On filing of an appeal to the board of appeals a day of hearing will be fixed and due notice thereof given to the appellant. He shall on or before the day of hearing file a brief of the authorities and arguments on which he will rely to maintain his appeal.

*Application Remanded for Reconsideration on Affidavits*

138. Affidavits received after the case has been appealed will not be admitted without remanding the application to the primary examiner for reconsideration; but the appellate tribunals may in their discretion refuse to remand the case and proceed with the same without consideration of the affidavits.

*Decision of Board of Appeals*

139. The board of appeals in its decision shall affirm or reverse the decision of the primary examiner only on the points on which appeal shall have been taken. (See rule 133.) Should it discover any apparent grounds not involved in the appeal for granting or refusing letters patent in the form claimed, or in any other form, it shall include in its decision a statement to that effect with its reasons for so holding.

This statement of the board of appeals, if adverse to applicant's right to a patent, will reopen the case for amendment or showing of facts, or both, before the primary examiner responsive thereto. The statement shall be binding upon the primary examiner unless an amendment or

showing of facts not previously of record be made which, in the opinion of the primary examiner, avoids the additional grounds for refusal of the patent stated in the decision.

The applicant may waive the right to further prosecution before the primary examiner and have the case reconsidered by the board of appeals upon the same record. Where request for such reconsideration is made the board of appeals shall render a new decision which shall include all grounds upon which a patent is refused. The applicant may waive reconsideration by the board of appeals and treat the decision, including the added grounds for refusal of a patent given by the board of appeals, as a final decision in the case.

### *Board of Appeals Amendment Referred to Primary Examiner*

Should the decision of the board of appeals include a statement that the patent may be granted in amended form, applicant shall have the right to amend in conformity with such statement, which shall be binding on the primary examiner in the absence of new references or grounds of rejection.

Cases in which appeals were pending and heard before the examiners in chief prior to May 2, 1927, and in which appeal was taken from their decision to the Commissioner will be governed by the rules in effect on March 2, 1927.

### *Rehearings*

140. Cases which were decided by the examiners in chief or which have been decided by the Commissioner or by the board of appeals will not be reopened by the primary examiner, except under the provisions of rule 139, without the written authority of the Commissioner, and then only for the consideration of matters not already adjudicated upon, sufficient cause being shown. (Rule 68.)

### *Jurisdiction*

141. After decision by an appellate tribunal the case shall be remanded at once to the primary examiner, subject to the applicant's right of appeal, for such action as will carry into effect the decision, or for such further action as the applicant is entitled to demand.

### *Petition to Commissioner without Fee*

142. Upon receiving a petition stating concisely and clearly any proper question which has been twice acted upon by the examiner, and

which does not involve the merits of the invention claimed, the rejection of a claim or a requirement for division, and also stating the facts involved and the point or points to be reviewed, an order will be made directing the examiner to furnish a written statement of the grounds of his decision upon the matters averred within five days. The examiner shall at the time of making such statement furnish a copy thereof to the petitioner. No fee is required for such a petition. Hearing will be granted in the discretion of the Commissioner.

## Appeals to the Board of Appeals in Contested Cases

### *Briefs in Appealed Cases*

143. In interference cases parties have the same remedy by appeal to the board of appeals as in *ex parte* cases.

144. Appeals in interference cases must be accompanied by brief statements of the reasons therefor. Parties will be required to file six copies of printed briefs of their arguments, with service upon each adverse party as provided in rule 154 (*b*), the appellant thirty days before the hearing and the appellee ten days. (See rule 163.)

### *Right to Open and Close*

145. The appellant shall have the right to make the opening and closing arguments, unless it shall be otherwise ordered by the tribunal having jurisdiction of the case.

### *Jurisdiction*

146. Contested cases will be regarded as pending before a tribunal until the limit of appeal, which must be fixed, has expired, or until some action has been had which waives the appeal or carries into effect the decision from which appeal might have been taken.

## Reconsideration of Cases Decided by Former Commissioner

147. Cases which have been decided by one Commissioner will not be reconsidered by his successor except in accordance with the principles which govern the granting of new trials.

## Appeals to the U. S. Court of Customs and Patent Appeals

### *Appeal to Court*

148. From the adverse decision of the board of appeals upon the claims of an application and in interference cases, an appeal may be

taken to the U. S. Court of Customs and Patent Appeals in the manner prescribed by the rules of that court.

*Notice to Commissioner of Appeal to Court*

149. When an appeal is taken to the U. S. Court of Customs and Patent Appeals, the appellant shall give notice thereof to the Commissioner, and file in the Patent Office, within forty days, exclusive of Sundays and holidays but including Saturday half holidays, from the date of the decision appealed from, his reasons of appeal specifically set forth in writing.

If an applicant in an *ex parte* case appeals to the U. S. Court of Customs and Patent Appeals he waives his right to proceed under section 4915 R. S.

If a defeated party to an interference proceeding, who is an applicant, appeals to the U. S. Court of Customs and Patent Appeals, his appeal will be dismissed if any adverse party to the interference shall, within twenty days after the appellant shall have filed notice of the appeal to the court, file notice with the Commissioner that he elects to have all further proceedings conducted as provided in section 4915 R. S. The notice of election must be served as provided in rule 154 (*b*). [See rule 153 (*a*).] If the appellant files a bill under section 4915 R. S. within thirty days after the notice of election, and files due proof thereof with the Commissioner of Patents, the issue of a patent to the party awarded priority by the board of appeals will be withheld pending final determination of the proceeding under section 4915 R. S.

From adverse decisions by the board of appeals, in both *ex parte* and contested cases, the appellant, if an applicant, has the option of proceeding under section 4915 R. S. instead of appealing directly to the U. S. Court of Customs and Patent Appeals.

Pro Forma *Proceedings in Patent Office*

150. *Pro forma* proceedings will not be had in the Patent Office for the purpose of securing to applicants an appeal to the U. S. Court of Customs and Patent Appeals.

(For forms of appeals and rules of the U. S. Court of Customs and Patent Appeals respecting appeals, see "Rules of Practice."

## Hearings

*Hour of Hearing*

151. Hearings will be had by the board of appeals at the hour stated in the notice and by the examiner of interferences upon interlocutory

matters at 10 o'clock a. m., and upon final hearings at 11 o'clock a. m., on the day appointed unless some other hour be specifically designated. If either party in a contested case, or the appellant in an *ex parte* case, appear at the proper time, he will be heard. After the day of hearing, a contested case will not be taken up for oral argument except by consent of all parties. If the engagements of the tribunal having jurisdiction be such as to prevent the case from being taken up on the day of hearing, a new assignment will be made, or the case will be continued from day to day until heard. Unless it shall be otherwise ordered before the hearing begins, oral arguments will be limited to one hour for each party in contested cases on final hearing and to one-half hour in other cases. After a contested case has been argued, nothing further relating thereto will be heard unless upon request of the tribunal having jurisdiction of the case; and all interviews for this purpose with parties in interest or their attorneys will be invariably denied. Petitions for rehearings or modification of the decision must be filed within thirty days after the decision or before the limit of appeal expires.

152. Hearings in *ex parte* and contested cases will, as far as is convenient and proper, be set, advanced, and adjourned to meet the wishes of the parties and their attorneys.

## Motions

### *Notice—Proof of Service—Jurisdiction—Right to Open and Close—Equity Practice in Cases to Which Rules Do not Apply*

153. In contested cases reasonable notice of all motions, and copies of motion papers and affidavits, must be served as provided in rule 154 (*b*). Proof of such service must be made before the motion will be entertained by the office. A statement of the attorney attached to or appearing on the original papers when filed clearly stating the time and manner in which service was made will be accepted as *prima facie* proof of service. Motions will not be set for hearing unless certified to by the applicant or an attorney of record that the motion is not interposed for purpose of delay and that it is believed to be well founded in law and fact. Motions will not be heard in the absence of either party except upon default after due notice. Motions will be heard in the first instance by the officer or tribunal before whom the particular case may be pending. In original hearings on motions the moving parties shall have the right to make the opening and closing arguments. In contested cases the practice on points to which the rules are not applicable shall conform as nearly as possible to that of the United States courts in equity proceedings.

(*a*). Every paper filed in the Patent Office in contested cases must be served upon the other parties as provided in rule 154 (*b*). This includes all appeals in such cases.

### Testimony in Interferences and Other Contested Cases

154. The following rules have been established for taking and transmitting testimony in interferences and other contested cases:

*Notice—Waiver—Reasonable Time for Travel*

(*a*) Before the depositions of witnesses shall be taken by either party due notice shall be given to the opposing party, as hereinafter provided, of the time when and place where the depositions will be taken, of the cause or matter in which they are to be used, and of the names and residences of the witnesses to be examined, and the opposing party shall have full opportunity, either in person or by attorney, to cross-examine the witnesses. If the opposing party shall attend the examination of witnesses not named in the notice, and shall either cross-examine such witnesses or fail to object to their examination, he shall be deemed to have waived his right to object to such examination for want of notice. Neither party shall take testimony in more than one place at the same time, nor so nearly at the same time that reasonable opportunity for travel from one place of examination to the other can not be had.

*Service of Notice*

(*b*) The notice for taking testimony or for motions must be served (unless otherwise stipulated in an instrument in writing filed in the case) upon the attorney of record, if there be one, or, if there be no attorney of record, upon the adverse party. Reasonable time must be given therein for such adverse party to reach the place of examination. Service of such notice may be made in either of the following ways: (1) By delivering a copy of the notice to the adverse party or his attorney; (2) by leaving a copy at the usual place of business of the adverse party or his attorney with some one in his employment; (3) when such adverse party or his attorney has no usual place of business, by leaving a copy at his residence, with a member of his family over 14 years of age and of discretion; (4) transmission by registered letter; (5) by express. Whenever it shall be satisfactorily shown to the Commissioner that neither of the above modes of obtaining or serving notice is practicable, the notice may be published in the Official Gazette. Such notice shall, with sworn proof of the fact, time, and mode of service thereof, be attached to the deposi-

tion or depositions, whether the opposing party shall have cross-examined or not.

*Official Certificate*

(*c*) Each witness before testifying shall be duly sworn according to law by the officer before whom his deposition shall be taken. The deposition shall be carefully read over by the witness, or by the officer to him, and shall then be subscribed by the witness in the presence of the officer unless the reading and the signature be waived on the record by agreement of all parties. The officer shall annex to the deposition his certificate showing (1) the due administration of the oath by the officer to the witness before the commencement of his testimony; (2) the name of the person by whom the testimony was taken down, and whether if not taken down by the officer it was taken down in his presence; (3) the presence or absence of the adverse party; (4) the place, day, and hour of commencing and taking the deposition; (5) whether or not the deposition was read by or to the witness before he signed the same; and (6) the fact that the officer was not connected by blood or marriage with either of the parties, nor interested, directly or indirectly, in the matter in controversy. The officer shall sign the certificate and affix thereto his seal of office, if he have such seal. Unless waived on the record by agreement of counsel he shall then, without delay, securely seal up all the evidence, notices, and paper exhibits, inscribe upon the envelope a certificate giving the title of the case, the name of each witness, and the date of sealing, address the package, and forward the same to the Commissioner of Patents. If the weight or bulk of an exhibit shall exclude it from the envelope, unless waived on the record by agreement of all parties, it shall be authenticated by the officer and transmitted in a separate package, marked and addressed as above provided.

*Motion to Extend Time for Taking Testimony*

(*d*) If a party shall be unable to take any testimony within the time limited, and desire an extension for such purpose, he must file a motion, accompanied by a statement under oath setting forth specifically the reason why such testimony has not been taken, and distinctly averring that such motion is made in good faith, and not for the purpose of delay. If either party shall be unable to procure the testimony of a witness or witnesses within the time limited, and desire an extension for such purpose, he must file a motion, accompanied by a statement under oath setting forth the cause of such inability, the name or names of such witness or witnesses, the facts expected to be proved by such witness or

witnesses, the steps which have been taken to procure such testimony, and the dates on which efforts have been made to procure it. (See rule 153.)

*Official Records and Special Matter Offered in Evidence*

(*e*) Upon notice given to the opposite party before the closing of the testimony, any official record, and any special matter contained in a printed publication, if competent evidence and pertinent to the issue, may be used as evidence at the hearing.

*Depositions to Be Filed in Patent Office*

(*f*) All depositions which are taken must be duly filed in the Patent Office. On refusal to file, the office at its discretion will not further hear or consider the contestant with whom the refusal lies; and the office may, at its discretion, receive and consider a copy of the withheld deposition, attested by such evidence as is procurable.

*Formalities*

155. The pages of each deposition must be numbered consecutively, and the name of the witness plainly and conspicuously written at the top of each page. The testimony preferably should be written upon legal paper, 8 by 13 inches, with a wide margin on the left-hand side of the page, and with the writing on one side only of the sheet.

156. The testimony will be taken in answer to interrogatories, with the questions and answers committed to writing in their regular order by the officer, or by some person not interested in the case either as a party thereto or as attorney. With the written consent of all parties present the testimony may be taken down stenographically and transcribed. The testimony shall be taken down by the officer or in his presence, except when his presence is waived on the record by agreement of the parties.

*Testimony Taken Stenographically—Officer Competent to Take Testimony*

Where testimony is taken stenographically, a longhand or typewritten copy shall be read to the witness, or read over by him, as soon as it can be made, and shall be signed by him as provided in paragraph (*c*) of rule 154 except when waived on the record by agreement of all parties. No officer who is connected by blood or marriage with either of the parties, or interested, directly or indirectly, in the matter in controversy,

either as counsel, attorney, agent, or otherwise, is competent to take depositions, unless with the written consent of all the parties.

In the absence of all opposing parties and their counsel, testimony may be taken in longhand, typewriting, or stenographically.

*Testimony Taken in One Interference May Be Used in Another*

157. Upon motion duly made and granted (see rule 153) testimony taken in an interference proceeding may be used in any other or subsequent interference proceeding, so far as relevant and material, subject, however, to the right of any contesting party to recall witnesses whose depositions have been taken, and to take other testimony in rebuttal of the depositions.

*Testimony Taken in Foreign Countries*

158. Upon motion duly made and granted (see rule 153) testimony may be taken in foreign countries, upon complying with the following requirements:

(*a*) The motion must designate a place for the examination of the witnesses at which an officer duly qualified to take testimony under the laws of the United States in a foreign country shall reside, and it must be accompanied by a statement under oath that the motion is made in good faith, and not for the purposes of delay or of vexing or harassing any party to the case; it must also set forth the names of the witnesses, the particular facts to which it is expected each will testify, and the grounds on which is based the belief that each will so testify.

(*b*) It must appear that the testimony desired is material and competent, and that it can not be taken in this country at all, or can not be taken here without hardship and injury to the moving party greatly exceeding that to which the opposite party will be exposed by the taking of such testimony abroad.

(*c*) Upon the granting of such motion, a time will be set within which the moving party shall file in duplicate the interrogatories to be propounded to each witness, and serve a copy of the same upon each adverse party, who may, within a designated time, file, in duplicate, cross-interrogatories. Objections to any of the interrogatories or cross-interrogatories may be filed at any time before the depositions are taken, and such objections will be considered and determined upon the hearing of the case.

(*d*) As soon as the interrogatories and cross-interrogatories are decided to be in proper form, the Commissioner will cause them to be forwarded to the proper officer, with the request that, upon payment of,

or satisfactory security for, his official fees, he notify the witnesses named to appear before him within a designated time and make answer thereto under oath; and that he reduce their answers to writing, and transmit the same, under his official seal and signature, to the Commissioner of Patents with the certificate prescribed in rule 154 (*c*).

(*e*) By stipulation of the parties the requirements of paragraph (*c*) as to written interrogatories and cross-interrogatories may be dispensed with, and the testimony may be taken before the proper officer upon oral interrogatories by the parties or their agents.

(*f*) Unless false swearing in the giving of such testimony before the officer taking it shall be punishable as perjury under the laws of the foreign state where it shall be taken, it will not stand on the same footing in the Patent Office as testimony duly taken in the United States; but its weight in each case will be determined by the tribunal having jurisdiction of such case.

### *Evidence on Hearing—Formal Objections to Evidence—Rules of Evidence*

159. Evidence touching the matter at issue will not be considered on the hearing which shall not have been taken and filed in compliance with these rules. But notice will not be taken of merely formal or technical objections which shall not appear to have wrought a substantial injury to the party raising them; and in case of such injury it must be made to appear that, as soon as the party became aware of the ground of objection, he gave notice thereof to the office, and also to the opposite party, informing him at the same time that, unless it be removed, he (the objector) will urge his objection at the hearing. This rule is not to be so construed as to modify established rules of evidence, which will be applied strictly in all practice before the office.

### *Subpœnas*

160. The law requires the clerks of the various courts of the United States to issue subpœnas to secure the attendance of witnesses whose depositions are desired as evidence in contested cases in the Patent Office.

### *Inspection—Printing*

161. After testimony is filed in the office it may be inspected by any party to the case, but it can not be withdrawn for the purpose of printing. It may be printed by some one specially designated by the office for that purpose, under proper restrictions.

*Copies of Testimony*

162. Thirty-one or more printed copies of the testimony must be furnished—five for the use of the office, one for each of the opposing parties, and twenty-five for the U. S. Court of Customs and Patent Appeals should appeal be taken. If no appeal be taken, the twenty-five copies will be returned to the party filing them. The preliminary statement required by rule 110 must be printed as a part of the record. These copies of the record of the junior party's testimony must be filed not less than fifty-five days before the day for final hearing, and in the case of the senior party not less than thirty-five days. The size of the record shall be $7\frac{5}{8}$ by $10\frac{1}{4}$ inches and the type matter shall be $4\frac{1}{6}$ by $7\frac{1}{6}$ inches. They shall be printed in 11-point type and adequately leaded; and the paper must be opaque and unglazed. The names of the witnesses must appear at the top of the pages over their testimony, and the record must contain indexes with the names of all witnesses and reference to the pages where copies of papers and documents introduced as exhibits are shown.

*Printing Dispensed With*

Where, however, a record does not exceed one hundred and twenty-five letter-sized double-spaced typewritten pages or the equivalent thereof, printing may be dispensed with upon request: *Provided, however,* That there shall be furnished, in addition to the original transcript, clearly legible copies of the typewritten testimony, which shall be certified to as being true copies by the party filing the same, one for the office, which shall not become part of the record, and one for each adverse party, to be filed within the time specified for filing printed copies: *And provided further,* That where printing has thus been dispensed with, the appellant, if appeal is taken from the decision of the examiner of interferences, may file three clearly legible typewritten copies of the record, both of his own and the appellee, if the same have not been printed, and which shall not become a part of the record, within thirty days from the taking of the appeal. If the copies of the record are not filed within the time specified or within any extension thereof granted by the board of appeals, the appeal shall be dismissed.

When it shall appear, on motion duly made and by satisfactory proof, that a party, by reason of poverty, is unable to print his testimony, the printing may be dispensed with; but in such case typewritten copies must be furnished—one for the office and one for each adverse party.

## Briefs

### *Size and Time of Filing*

163. Briefs at final hearing and on appeals from final decisions in contested cases shall be submitted in printed form and shall be of the same size and the same as to page and print as the printed copies of testimony. Where the brief does not exceed thirty legal-sized double-spaced typewritten pages or the equivalent thereof, and in any case where satisfactory reason therefor is shown, typewritten briefs may be submitted. Four copies of the brief at final hearing shall be filed by each party on dates to be set by the examiner of interferences, provided that the date as to the senior party shall be not less than fifteen days after the filing by the junior party and not less than ten days before final hearing. Service to be as provided in rule 154 (*b*). Briefs on appeals shall be filed as provided in rule 144.

At interlocutory hearings and on appeal from interlocutory decisions typewritten briefs may be used. Briefs in support of or opposition to motions under rule 109 and rule 122 and appeals thereon shall, except as hereinafter provided, be filed in the Patent Office not less than ten days prior to the date of hearing with proof of service on the opposing parties under the provisions of rule 154 (*b*), and if not so filed consideration thereof may be refused. By stipulation of the parties or by order of the tribunal before whom the hearing is had briefs may be filed otherwise than as here prescribed.

## Issue

### *Notice of Allowance*

164. If, on examination, it shall appear that the applicant is justly entitled to a patent under the law, a notice of allowance will be sent him or his attorney, calling for the payment of the final fee within six months from the date of such notice of allowance, upon the receipt of which within the time fixed by law the patent will be prepared for issue. (See rules 167, 194.)

### *Withdrawal from Issue—New Notice*

165. After notice of the allowance of an application is given, the case will not be withdrawn from issue except by approval of the Commissioner, and if withdrawn for further action on the part of the office a new notice of allowance will be given. When the final fee has been paid upon an application for letters patent, and the case has received its

date and number, it will not be withdrawn from issue on account of any mistake or change of purpose of the applicant or his attorney, nor for the purpose of enabling the inventor to procure a foreign patent, nor for any other reasons except mistake on the part of the office, or because of fraud, or illegality in the application, or for interference. (See rule 78.)

*Withdrawal from Issue Will Not Stay Abandonment*

166. Whenever the Commissioner shall direct the withdrawal of an application from issue on request of an applicant for reasons not prohibited by rule 165, this withdrawal will not operate to stay the period of six months provided by rule 77 running against the application, which begins to attach from the date of the notice of allowance.

### Date, Duration, and Form of Patents

*Date of Patent—Patent Withheld—Weekly Issue and Final Fees*

167. Every patent shall issue within a period of three months from the date of the payment of the final fee, which fee shall be paid not later than six months from the time at which the application was passed and allowed and notice thereof was sent to the applicant or his agent; and if the final fee be not paid within that period the patent shall be withheld. (See rule 175.) In the absence of request to suspend issue the patent will issue in regular course. The issue closes weekly on Thursday, and the patents bear date as of the fourth Tuesday thereafter.

A patent will not be antedated.

*Title of Invention—Grant—Term—Term of Design Patent*

168. Every patent will contain a short title of the invention or discovery indicating its nature and object, and a grant to the patentee, his heirs and assigns, for the term of seventeen years, of the exclusive right to make, use, and vend the invention or discovery throughout the United States and the Territories thereof. The duration of a design patent may be for the term of three and one-half, seven, or fourteen years, as provided in rule 80. A copy of the specification and drawings will be annexed to the patent and form part thereof.

### Delivery

*Delivery of Patent*

169. The patent will be delivered or mailed on the day of its date to the attorney of record, if there be one; or, if the attorney so request,

to the patentee or assignee of an interest therein; or, if there be no attorney, to the patentee or to the assignee of the entire interest, if he so request.

### Correction of Errors in Letters Patent

#### *Correction of Mistakes Incurred through Fault of the Office*

170. Whenever a mistake, incurred through the fault of the office, is clearly disclosed by the records or files of the office, a certificate, stating the fact and nature of such mistake, signed by the Commissioner of Patents, and sealed with the seal of the Patent Office, may, at the request of the patentee or his assignee, be indorsed without charge upon the letters patent, and recorded in the records of patents, and a printed copy thereof attached to each printed copy of the specification and drawing.

#### *Not Incurred Through Fault of the Office*

Mistakes not incurred through the fault of the office, and not affording legal grounds for reissues, will not be corrected after the delivery of the letters patent to the patentee or his agent.

Changes or corrections will not be made in letters patent after the delivery thereof to the patentee or his attorney, except as above provided.

### Abandoned, Forfeited, Revived, and Renewed Applications

#### *Abandoned Application*

171. An abandoned application is one in which all the essential parts have not been filed so that it is completed and prepared for examination within a period of six months, or which the applicant has failed to prosecute within six months after any action therein of which notice has been duly given (see rules 31 and 77), or which the applicant has expressly abandoned by filing in the office a written declaration of abandonment, signed by himself and assignee, if any, identifying his application by title of invention, serial number, and date of filing. (See rule 60.)

Prosecution of an application to save it from abandonment must include such proper action as the condition of the case may require. The admission of an amendment not responsive to the last official action, or refusal to admit the same, and any proceedings relative thereto, shall not operate to save the application from abandonment under section 4894 of the Revised Statutes.

*Revival of Application*

172. Before an application abandoned by failure to complete or prosecute can be revived as a pending application it must be shown to the satisfaction of the Commissioner that the delay was unavoidable.

*New Application*

173. When a new application is filed in place of an abandoned or rejected application, a new petition, specification, oath, and fee will be required; but the old drawing, if suitable, may be used upon the filing of suitable permanent photographic copies thereof.

*Forfeited or Withheld Application*

174. A forfeited application is one upon which a patent has been withheld for failure to pay the final fee within the prescribed time. (See rule 167.)

*New Application After Nonpayment of Final Fee*

175. When the patent has been withheld by reason of nonpayment of the final fee, any person, whether inventor or assignee, who has an interest in the invention for which the patent was ordered to issue may file a renewal of the application for the same invention; such renewal of the application may be filed any time after the case is allowed and such renewal will be taken as a waiver of the right to pay the final fee. But any renewal application must be made within one year after the allowance of the original application.

*Renewal—Old Application Papers May Be Used*

176. In a renewal the oath, petition, specification, drawing, and model of the original application may be used; but a new fee will be required. The renewal application will not be regarded for all purposes as a continuation of the original one, but must bear date from the time of renewal and be subject to examination like an original application.

*Not Cited as References*

177. Forfeited and abandoned applications will not be cited as references.

*No Notice of Subsequent Applications*

178. Notice of the filing of subsequent applications will not be given to applicants while their cases remain forfeited.

### *Copies*

179. Copies of the files of forfeited and abandoned applications may be furnished when ordered by the Commissioner. The requests for such copies must be presented in the form of a petition properly verified as to all matters not appearing on record in the Patent Office.

## Extensions

180. Patents can not be extended except by act of Congress.

## Disclaimers

### *Disclaimers—Grounds, Form, and Effect*

181. Whenever, through inadvertence, accident, or mistake, and without any fraudulent or deceptive intention, a patentee has claimed as his invention or discovery more than he had a right to claim as new, his patent will be valid for all that part which is truly and justly his own, provided the same is a material or substantial part of the thing patented; and any such patentee, his heirs or assigns, whether of the whole or any sectional interest therein, may, on payment of the fee required by law ($10), make disclaimer of such parts of the thing patented as he or they shall not choose to claim or to hold by virtue of the patent or assignment, stating therein the extent of his interest in such patent. Such disclaimer shall be in writing, attested by one or more witnesses, and recorded in the Patent Office; and it shall thereafter be considered as part of the original specification to the extent of the interest possessed by the claimant and by those claiming under him after the record thereof. But no such disclaimer shall affect any action pending at the time of filing the same, except as to the question of unreasonable neglect or delay in filing it.

### *Different Kinds of Disclaimers*

182. The statutory disclaimers treated in rule 181 are to be distinguished from those which are embodied in original or reissue applications, as first filed or subsequently amended, referring to matter shown or described, but to which the disclaimant does not choose to claim title, and also from those made to avoid the continuance of an interference. The disclaimers falling within this present rule must be signed by the applicant in person and require no fee. (See rule 107. For forms of disclaimers see appendix, Forms 26 and 27.)

## Assignments

### *Assignability of Patents*

183. Every patent or any interest therein is assignable in law by an instrument in writing; and the patentee or his assigns or legal representatives may, in like manner, grant and convey an exclusive right under the patent to the whole or any specified part of the United States.

### *In Whom May Be Vested*

184. Interest in patents may be vested in assignees, in grantees of exclusive territorial rights, in mortgages, and in licensees.

### *Assignees*

(*a*) An assignee is a transferee of the whole interest of the original patent or of an undivided part of such whole interest, extending to every portion of the United States. The assignment must be written or printed and duly signed.

### *Grantees*

(*b*) A grantee acquires by the grant the exclusive right, under the patent, to make, use, and vend, and to grant to others the right to make, use, and vend, the thing patented within and throughout some specified part of the United States, excluding the patentee therefrom. The grant must be written or printed and be duly signed.

### *Mortgages*

(*c*) A mortgage must be written or printed and be duly signed.

### *Licenses*

(*d*) A licensee takes an interest less than or different from either of the others. A license may be oral, written, or printed, and if written, or printed, must be duly signed.

### *Recording*

185. An assignment, grant, or conveyance of a patent will be void as against any subsequent purchaser or mortgagee for a valuable consideration without notice unless recorded in the Patent Office within three months from the date thereof or prior to such subsequent purchase or mortgage.

### *Acknowledgment*

If any assignment, grant, or conveyance of any patent shall be acknowledged before any notary public of the several States or Territories or the District of Columbia, or any Commissioner of any court of the United States for any District or Territory, or before any secretary of legation or consular officer authorized to administer oaths or perform notarial acts under section 1750 of the Revised Statutes, the certificate of such acknowledgment, under the hand and official seal of such notary or other officer, shall be *prima facie* evidence of the execution of such assignment, grant, or conveyance.

### *Instruments Eligible for Recording*

186. No instrument will be recorded which is not in the English language and which does not, in the judgment of the Commissioner, amount to an assignment, grant, mortgage, lien, incumbrance, or license, or which does not affect the title of the patent or invention to which it relates. Such instrument should identify the patent by date and number; or, if the invention be unpatented, the name of the inventor, the serial number, and date of the application should be stated.

### *Conditional Assignments*

187. Assignments which are made conditional on the performance of certain stipulations, as the payment of money, if recorded in the office are regarded as absolute assignments until canceled with the written consent of both parties or by the decree of a competent court. The office has no means for determining whether such conditions have been fulfilled.

### *Issue to Assignee—Date of Record*

188. In every case where it is desired that the patent issue to an assignee, the assignment must be recorded in the Patent Office at a date not later than the day on which the final fee is paid. In the case of an application for a design patent the assignment must be recorded before the case is allowed. (See rule 26.) The date of the record is the date of the receipt of the assignment at the office in proper form and accompanied by the full legal fee for recording.

### *Receipt, Recording, and Return of Assignments*

189. The receipt of assignments is generally acknowledged by the office. They are recorded in regular order as promptly as possible, and then transmitted to the persons entitled to them.